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Cambodia's Agricultural Strategy: Future Development Options for the Rice Sector

A Policy Discussion Paper

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Xinshen Diao, Ph.D. Senior Research Fellow
International Food Policy Research Institute, Washington, D.C.

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Acronyms & Abbreviations

ADB	Asian Development Bank
CAASP	Cambodia Agriculture and Agribusiness Support Program
CARD	Council for Agricultural and Rural Development
CDRI	Cambodia Development Resource Institute
CEDAC	Centre d'Etude et de Développement Agricole Cambodgien
CSES	Cambodia Socio-Economic Survey
EIC	Economic Institute of Cambodia
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
MAFF	Ministry of Agriculture, Forestry and Fishery
MoC	Ministry of Commerce
MOP	Ministry of Planning
MOWRAM	Ministry of Water Resources and Meteorology
NIS	National Institute of Statistics
NSDP	National Strategic Development Plan
R&D	Research and Development
RGC	Royal Government of Cambodia
SAW	Strategy for Agriculture and Water
SRI	System of Rice Intensification
USDA	United States Department of Agriculture
WDI	World Development Indicator

Executive Summary

This paper focuses on the role of the rice sector in Cambodian agriculture strategy. The paper first reviews the performance of the rice sector in Cambodian agriculture and rice-related government policies and interventions, and it then identifies potential and constraints for future development of the rice sector. Against the background of a broad agricultural strategy, the paper further explores the options and possible development path for rice in the future by comparing the current situation in Cambodia with its two neighbors, Thailand and Vietnam, in their early development stage. Although both Thailand and Vietnam are rice growing and exporting countries, they have quite different rice development strategies. The paper concludes with a set of further research topics in which we emphasize Cambodia's comparative advantage, and propose a comparison study of different development paths in rice development and agricultural diversification. Such comparisons may provide more options to inform Cambodia's agricultural development strategy in the future.

Cambodia has undergone a dramatic economic transformation, with an impressive GDP growth rate of 9.8 percent in 2000-08, exceeding most countries in the region. This rapid growth is accompanied by remarkable performance in the agricultural sector, which grew at 5.6 percent per year over the same period. Nevertheless, Cambodia's economy is still highly dependent on agriculture, which contributes close to one-third of national GDP and employs more than half of the total labor force.

Rice is the dominant crop in Cambodian agriculture. It occupies more than 80 percent of cultivated land and is the most important agricultural export commodity. Rice is also the main source of crop value added and the major driver of agricultural growth. As the staple of the traditional diet, rice provides more than three quarters of daily energy intake for the average Cambodian. Therefore, rice has played and will continue to play a strategic role in income growth, poverty reduction, and national and household food security.

Recognizing the important role of rice, the Cambodian government has paid special attention to this sector, as rice appears in government strategy and planning documents wherever agriculture is mentioned. Yield improvement through intensification (such as irrigation and fertilizer use) has been highlighted as the top priority for promoting agricultural growth, rather than further expansion of the farmed land area. According the Cambodia Agriculture and Agribusiness Support Program (CAASP), rice production is set to reach 6 million tons in 2010, and further rise to 7.5 million tons by 2020. This growth will be propelled by yield growth from 2.5 ton/ha in 2007 to 3.0 ton/ha in 2020. At the same time, the harvested rice area is projected to decline slightly but the proportion of irrigated land will increase to 20 percent.

With strong government support, rice production has grown rapidly since 2003. Non-irrigated wet season rice accounts for more than 75 percent of total rice production, and growth in wet season rice output was primarily responsible for more than doubling yield during 1994-2008. Rapid growth in rice production has turned Cambodia from a net rice importer to an exporter. Cambodia's rice export recorded 1.5 million tons in 2007, contributing 10 percent of the country's total export value. Despite the impressive growth in rice production and exports, however, only a small portion of rice production goes to foreign markets, substantially below the export level reached by Vietnam and Thailand.

Cambodia has huge potential to increase rice production. The country is known for its abundant agricultural land and water resources. Such natural resource potential has been underutilized: less than 30 percent of potential arable land is under cultivation, and a much smaller portion of area

suitable for irrigation is actually irrigated. Therefore, expansion of farmed land area and irrigation development can be a straightforward ways to increase rice production. Productivity is another source of rice development potential, as average rice yields in Cambodia remain below the levels in Thailand and Vietnam. Rice yield could increase substantially through crop intensification techniques including both increased use of fertilizer and better farming practices such as those identified under the System of Rice Intensification (SRI).

While rice will continue to play an important role in Cambodia's future agricultural growth, it is necessary to put the rice sector in a broad development context to identify better options for its further development. Rice played a similar important role in the economic development process in Thailand in the early 1960s and 1970s and in Vietnam in the 1990s as it does in Cambodia today. A comparison between Cambodia's present conditions and a similar development stage in Thailand's and Vietnam's past helps us recognize practical options for Cambodia's rice sector.

Cambodia's recent growth, measured in per capita income, has been more rapid than that of both Thailand and Vietnam in the past when they started at a similar income level. While the recent global recession slowed Cambodia's economic growth in 2009, growth is expected to recover in 2010 and 2011, and the gap in per capita GDP between Cambodia and Vietnam will likely decrease in the next decade. Future growth in Cambodia's economy may not rely heavily on agriculture, particularly on rice, however agriculture will still be important in many respects. Although the speed of economic structural change in Cambodia today is comparable with Vietnam and Thailand in the past, the initial conditions in the economic structure at the similar per capita income level are quite different among the three countries. The share of agriculture in Cambodia's economy is higher than it was in Thailand or Vietnam at a similar income level. It seems reasonable to predict that the role of agriculture in the next 10 years in Cambodia will be relatively more important than in the two neighboring countries in the past at the comparable per capita income level, not only because of differences in the initial conditions, but also due to the unprecedented recent global recession.

A comparison of current rice yields in Cambodia, Thailand, and Vietnam reveals that while Cambodia's rice yield is half that of Vietnam, there is only a modest 10 percent yield gap between Cambodia and Thailand. Although Vietnam is often used as an example to argue the yield potential in Cambodia, the two countries have significant differences in initial conditions. Cambodia's rice yield was 1.8 ton/ha in 1997, but at a comparable per capita income level in its past (in 1991), Vietnam had already reached an average rice yield of more than 3 ton/ha. Vietnam raised its rice yield to 4 ton/ha over the next seven years to 1998, while in a similar period of time, Cambodia only managed to increase rice yield to 2 ton/ha (in 2004).

On the other hand, Thailand's experience seems to be more relevant to Cambodia. First, Cambodia and Thailand share similar natural resource conditions, as both countries are relatively land abundant by regional standards. Second, the fertilizer application rate and irrigation coverage are low in Thailand compared with Vietnam. Thailand's competitiveness in the world rice market is less related to yield improvement than in Cambodia, as increased production is the result of both area expansion and yield improvement. Third, one unique feature of Thailand's rice sector is its diversification to meet different demand from foreign markets. High-quality Thai rice often targets developed country markets or consumers in developing countries with relatively higher income, while low-price rice has helped Thailand penetrate rice markets in many African countries. Cambodian rice varieties cultivated for export receive a high price premium due to superior taste and quality preferred by upscale consumers. The Thailand experience suggests that instead of emphasizing productivity simply measured by rice yield, the focus of Cambodia's rice strategy

should be to increase rice competiveness by exploring export opportunities such as targeting niche markets and cultivating different varieties for different types of consumers in foreign countries.

Results from a simulation exercise based on the estimated supply response of increased use of inputs and land expansion also supports this argument. The results indicate that, given Cambodia's current situation, output increase through area expansion can be substantially larger than output increase through intensification of modern inputs. The results further confirm that the comparative advantage of Cambodia's rice sector lies in its abundant land resources; therefore, policies focusing on rice yield alone might not be the most effective way to make rice more profitable for farmers. Since Cambodia already reached food self sufficiency at the national level in the late 1990s, a continuous emphasis on increasing rice production might result in an oversupply of rice and missed market opportunities in high value rice varieties and other high value crops. More research needs to pay attention to how Cambodia can exploit its comparative advantage by exporting high quality rice with higher value addition. It is important to examine the trade-offs between different rice development goals, such as yield increase vs. diversified, high quality rice development. In addition, Cambodia can draw valuable lessons from Thailand's experience in promoting agricultural research and development (R&D) to improve the quality and taste of rice varieties. Such research needs to take into consideration the impact of different rice development strategies on poverty, food security and nutrition at household level.

Research on crop diversification is also important for Cambodia's agricultural strategy. Upland crops like cassava and maize have potential for generating more income to farmers, supporting food security in some areas, and expanding the agricultural export earnings base. Related experiences and lessons of other Southeast Asian countries are worth studying. Crop diversification research should focus not only on production, but also diversification, as experiences from other Southeast Asian countries suggest that diversified food production can lead to consumption diversification, which has helped to improve rural households' nutritional status. The relationship between production diversification, consumption diversification, and nutrition improvement deserves more detailed study in the future.

In summary, developing an evidence-based agricultural strategy requires research to better understand Cambodia's comparative advantage and the available options to explore this advantage. It also requires a better understanding of the interactions between different growth options and growth outcomes in terms of income generation to the poor and food security and nutrition improvement. Finally, it requires prioritization and sequencing of public investment to promote agricultural growth.

1. Introduction

Cambodia has undergone dramatic political, economic and social changes since 1993, the year of the first post-conflict national elections leading to the first coalition government. Cambodia has joined various international and regional organizations and has been a member of World Trade Organization since October 2004. At the same time, the country has undertaken crucial institutional and economic reforms, which have led to impressive growth and development outcomes. The country's gross domestic product (GDP) grew by 9.8 percent annually between 2000 and 2008. Such growth exceeds that of the country's neighbors, Thailand and Vietnam and is higher than the East Asian and Pacific region as a whole (World Bank 2009). GDP per capita, measured in 2000 constant prices, has grown from $286 in 2000 to $492 in 2009, albeit still about one quarter of the East Asia and Pacific regional average of $1926. This rapid overall economic growth in Cambodia has been accompanied by remarkable performance in the agricultural sector, which grew at 5.6 percent between 2000 and 2008–the highest growth rate in the region in this period (Appendix Table 1). Nonetheless, Cambodia's economy is still highly dependent on agriculture, which contributed close to one-third of national GDP in recent years.

Agriculture is also the most important sector for employment, employing more than half of the country's total labor force. Agriculture is more important for the rural poor as it provides their most important source of income (World Bank 2009). According to Knowles (2006), the poorest 10 percent of the Cambodian population are rural households, mostly depending on agriculture for their livelihood.

Rice is the dominant crop in Cambodian agriculture and a rice-based farming system has existed in the country for more than 2,000 years (Nesbitt 1997). As a low-income country, Cambodia is dependent on rice as a strategic commodity for income growth, poverty reduction, and national and household food security. For this reason, we focus on the role of the rice sector in Cambodian agriculture strategy in this paper. In the next section, we first highlight the importance of the rice sector in the current economy and then review the recent government policies and interventions in rice promotion. Section 3 provides a brief description of the recent performance of the rice sector. Section 4 focuses on the potential and constraints for future development of the rice sector. Against the background of a broad agricultural strategy, in Section 5 we explore the options and possible development path for rice in the future by comparing the current situation in Cambodia with its two neighbors, Thailand and Vietnam, in their early development stages. Although both Thailand and Vietnam are rice growing and exporting countries, they have quite different rice development strategies. Section 6 concludes the paper with a set of further research topics in which we emphasize Cambodia's comparative advantage, and propose a comparison study of different development paths in rice development and agricultural diversification. Such comparisons may provide more options to inform Cambodia's agricultural development strategy in the future.

2. Rice in Cambodian Agriculture and Rice Promotion Policies

Rice-based farming systems have been the backbone of Cambodia's agriculture, with a long history, and rice remains the dominant crop even today. Adapting to different local soil and weather conditions, Cambodian farmers have rich experience in rice production and have developed various rice farming systems such as rainfed lowland rice, rainfed upland rice, deepwater rice, and irrigated dry season rice. Moreover, rice is a dominant crop for almost all farmers: more than 80 percent of Cambodian farmers grow rice (CSES 2004 and 2007). Rice production occupies more than 80 percent of cultivated land and provides more than 50 percent of crop value added nationwide (MAFF

various years). Rice is also one of the main drivers in agricultural growth, contributing nearly half of total crop growth in the 1994-2006 period. In recent years rice has become the most important agricultural export commodity. It contributed to more than 10 percent of the country's total export value in 2007, and has surpassed the country's traditional agricultural export commodities such as rubber and forestry products (IMF 2009).

As the staple of the traditional diet, rice provides more than three quarters of daily energy intake for the average Cambodian (MAFF and MOWRAM 2008). Due to the recent food price surge in 2007-08 that had a serious impact on the wellbeing of Cambodians, the national poverty rate is estimated to rise by 1.5 percentage points, -- 1.4 percentage points of which came from the rice price surge (Ivanic and Martin 2008).

Government Strategy and Planning: Rice is a Priority

Recognizing the strategic role of the rice sector in economic growth, poverty reduction and food security, the Cambodian government has paid special attention to this sector, and rice appears in government strategy and planning documents wherever agriculture is mentioned. For example, yield improvement through intensification (such as irrigation and fertilizer use) has been highlighted as the top priority for promoting agricultural growth, rather than further expansion of the farmed land area. Measures of intensification include the construction and maintenance of irrigation facilities, improved water resource management, enhanced input supply and delivery. Many of these measures target rice.

Following the Rectangular Strategy (2004), the 2006-2010 National Strategic Development Plan (NSDP) set a target for the rice sector: 5.5 million tons of rice production in 2010. This target is to be achieved through rice yield increase, from 2.0 ton/ha in 2005 to 2.4 ton/ha by 2010. In order to achieve this 20 percent yield improvement in a period of five years, the proportion of irrigated land (including supplemental irrigation) is set to expand from 20 percent in 2005 to 25 percent in 2010, which implies that irrigated rice area will increase to 650,000 hectares in 2010 from 588,687 hectares in 2005. In the 2008 Mid-Term Review of NSDP , the rice targets were revised to reflect a much higher level: the target of rice production for 2010 was adjusted to 7.5 million tons, from the original 5.5 million tons in 2006. To support this increased production target, the rice yield target rises to 2.8 ton/ha for 2010, instead of the original 2.4 ton/ha in the NSDP 2006-2010 document. The targeted rice irrigation area for 2010 is expected to expand to 867,000 hectares, 200,000 hectares more than in the original plan. To support these ambitious rice development goals, NSDP has allocated $990 million, or 13.8 percent of total budgeted resources of 2006-2010, for agricultural and land management, seasonal crops (mostly rice), and rural development (Appendix Table 2).

NSDP required a sector-specific 2006-2010 Strategy for Agriculture and Water (SAW) (MAFF and MOWRAM 2007), whose goal is "enhancing agricultural productivity and diversification and improving water resources development and management." The third component of SAW, the Cambodia Agriculture and Agribusiness Support Program (CAASP) focuses on food security and self-sufficiency (MAFF and MOWRAM 2008). The rice targets in this document are consistent with those in the 2006-2010 NSDP and hence are lower than that in the 2008 Mid-Term Review NSDP. The document also prioritizes types of irrigations by season: supplementary irrigation during the wet season and full irrigation in dry season.

Irrigation development has been seen as a key for rice development, and investment in irrigation, including improvement in current irrigation system and management, is among the top priorities of public investment in Cambodia. The share of public investment in the irrigation system over the

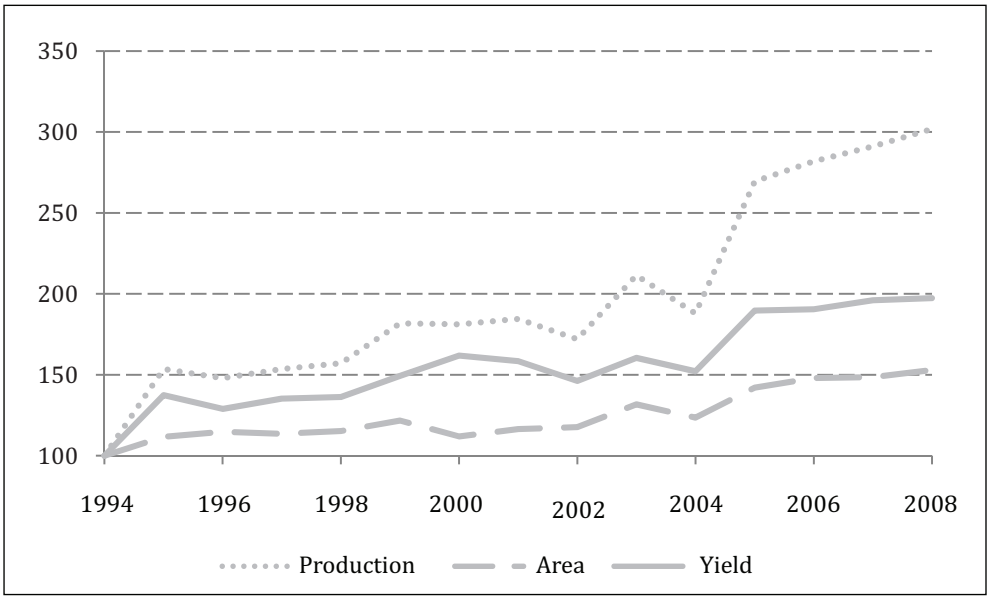
government's total development investment has increased significantly in recent years. As a result, the average irrigated paddy land, including wet season supplementary irrigation and dry season full irrigation, rose about 17 percent from 270 hectares to 320 hectares per commune (Phyrum 2007). In the years between 2007 and 2009, MOWRAM further doubled its irrigation investment. Total resources allocated to irrigation from government and external sources was $31.8 million in 2007 and jumped to $59.2 million per year in the following three years (Sophal *et al.* 2010). When compared with other expenditures for the agricultural sector, it is clear that there is a surge in investment to construct more new irrigation schemes and rehabilitate existing ones.

According to the SAW, $100 million of investment will be allocated to the Agricultural Program and another $100 million to the Water Resource and Irrigation Program, and in both of them rice has an important position. Agricultural research investment also emphasizes rice, as the SAW mentions high yield and high quality rice and varieties that are more tolerant to adverse weather and climate change. As indicated by the Research and Extension Program of SAW (MAFF and MOWRAM 2009), nearly one-third of its total research budget in 2010-2014 will be allocated to agricultural and water research.

3. Performance of Rice Sector in the Recent Years

With strong support from the government, rice production has grown rapidly since 2003, which has firmly changed the country's position from rice deficit to surplus. While rice harvest area continues to expand, increases in yield have become a more dominant factor for rice production growth (Figure 1). On average, rice yield grew at 3.9 percent per year between 1994 and 2007, rising from 1.6 ton/ha in 1994-1997 to 2.3 ton/ha in 2003-2007 (Appendix Table 3).

Figure 1: Growth of rice production, area, and yield in 1994-2008 (1994=100)



Source: Authors' calculation from USDA (2008).

Table 1 below disaggregates rice production by wet and dry seasons. Cambodia is dominated by non-irrigated wet season rice production, which accounts for more than 75 percent of total rice output. With the development of irrigation, dry season rice production grew more rapidly (5.8 percent)

than wet season production (4.6 percent) per year between 1994 and 2004. However, because the much smaller share of dry season rice in rice total production, wet season rice production continues to be the mainstay of rice production in the country. Dry season rice, accounting for about one fifth of rice production in 2007, remains an important component of rice production, particularly for consumers with different variety preferences.

Table 1: Rice Production by Wet and Dry Season, 1994-2008

					growth rate	
	Season	1994	2004	2008	1994-2004	2004-08
Production (000 ton)	Wet	17,285	31,326	44,954	4.57	10.88
	Dry	4950	10,377	10,962	5.75	1.41
	Total	22,235	41,703	55,916	4.84	8.52
Harvest area (000 'ha)	Wet	16,757	18,156	22,195	0.97	5.56
	Dry	1600	2934	3230	4.54	2.52
	Total	18,357	21,091	25,425	1.37	5.14
Yield (ton/ha)	Wet	1.0	1.7	2.3	3.57	8.74
	Dry	3.1	3.5	3.9	1.15	2.57
	Total	1.2	2.0	2.5	3.42	6.97
Comsumption (000 tons)	Total	13,871	19,059	20,960	3.01	2.49
Trade (000 tons)	Rice	12	200	450	117	31.25

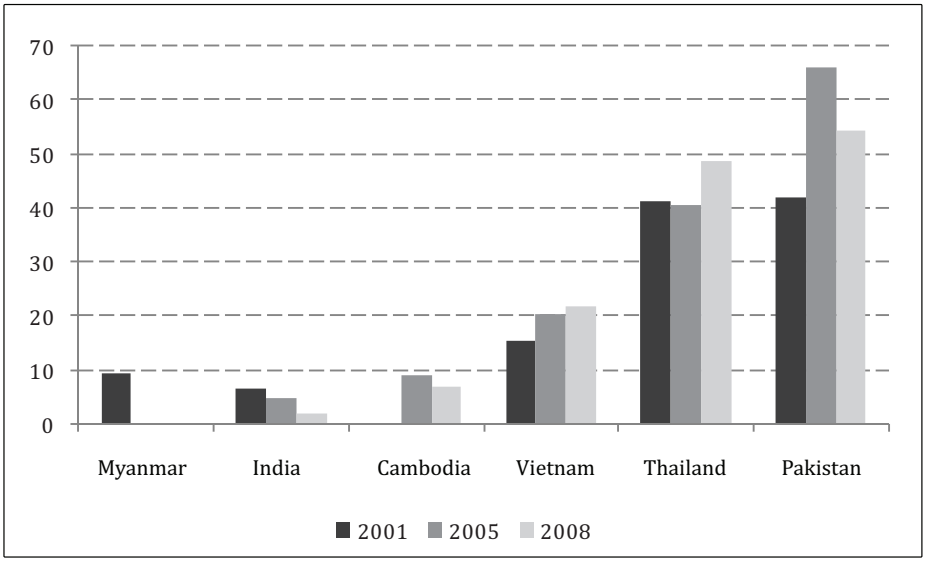
Source: MAFF (various years), MOP and NIS (2004).

Similar to the growth pattern for total rice production, growth in wet season rice output was primarily led by more than doubling its yield during the 1994-2008 period (Table 1). The yields of wet season rice increased from 1.0 ton/ha in 1994 to over 2.3 ton/ha in 2008. In contrast, area expansion is the main driver of dry season output growth, especially in the 1994-2004 period. However, the yield of dry season rice is still much higher than the wet season crop, even by taking into account the significant yield improvement for wet season rice in the last 10 years. Around 85 percent of the dry season rice is being cultivated with IR varieties, especially IR-66, because it is easy to manage its water requirement and hence the application of fertilizer (Koma 2008). However, in the case of wet season rice, most farmers still use traditional varieties, except for early wet-season rice (which is less than 10 percent of the cultivated rice area) for which farmers adopted the short-duration and photo-insensitive IR varieties.

Rapid growth in rice production has turned Cambodia from a net rice importer to an exporter. Although the country started to export rice in 2002, only in recent years have such exports reached a significant magnitude of 1.5 million tons (2007). Cambodia is still a small rice exporter in the world; its share in world rice trade has reached 2 percent in 2007 (FAO 2010). With a contribution of 10 percent of the country's total export value, rice has become the country's most important agricultural export product in recent years (IMF 2009). While the achievement in rice growth and exports is impressive, the share of rice exports in Cambodian total rice production is still substantially below its neighbors. For example, Vietnam currently exports 22 percent of its rice production, rising from 15 percent in the early 2000s, and in Thailand 40 to 50 percent of rice is produced for exports (Figure 2). It must be pointed out that the official statistics significantly underestimate the amount of Cambodian rice exports, given that informal trade between Cambodia and Vietnam, and Cambodia and Thailand is quite popular in the border regions. It is estimated

that approximately one-third of the paddy sold by farmers in this areas was exported unofficially through such channels (MAFF and MOWRAM 2008).

Figure 2: Percentage of Rice Export in Total Production, 2001-2008

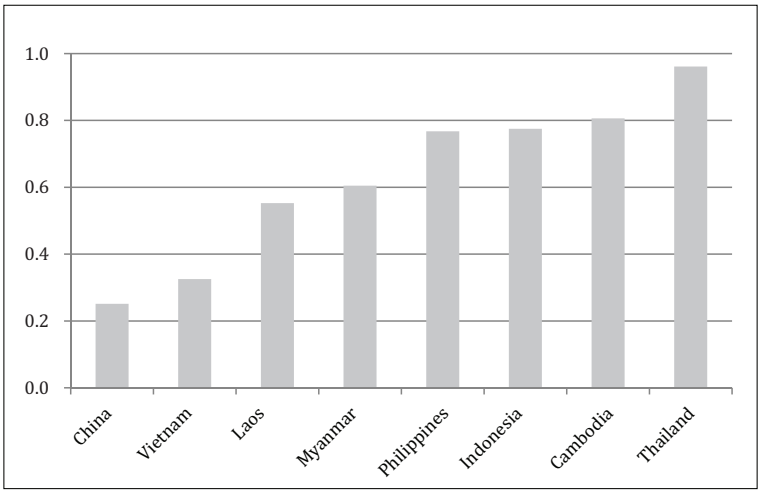


Source: Authors' calculation from USDA Production, Supply and Distribution Online (2008).

4. Future Rice Growth Potential and Constraints

Cambodia is known for its abundant agricultural land and water resources. Figure 3 shows the ratio of crop area to agricultural labor in East and Southeast Asian countries. Cambodia ranks higher than most of its neighbor countries and is only below Thailand for this ratio. This suggests that Cambodia and Thailand may share certain common natural resource endowment conditions in agricultural production as both countries are relatively land abundant by regional standards in the Mekong River Basin. Moreover, according to FAO (2000) and in terms of absolute area, Cambodia has more potential arable land than both Laos and Vietnam. Cambodia currently only uses less than 30 percent of its total potential arable land, which is substantially lower than other countries in the region.

Figure 3: Average Crop Area per Agricultural Labor, hectares



Source: Authors' calculation from FAOSTAT (2010).

Cambodia also has rich and unutilized water resources. According to Pech and Sunada (2008), there are 12 million hectares of land suitable for irrigation in northeast Thailand, and 95 percent of this land has been developed into agricultural crop areas, of which 12 percent is irrigated. In the Vietnam Delta, 88 percent of the land is suitable for irrigation and 60 percent of cultivated land has been already developed into irrigated agriculture. In contrast to the cases of Thailand and Vietnam, only 30 percent of area suitable for irrigation has been developed into agricultural land in Cambodia and irrigation accounts for a much small proportion of this land. Obviously, there is huge potential for Cambodia to develop agriculture particular rice through land expansion and irrigation development.

Productivity is another source of rice development potential in Cambodia. Although significant productivity gains have been achieved in the country since the end of the conflict, the average rice yield remained below those reached by neighboring countries. Rice yield and farmers' income could increase substantially through intensification techniques. Intensification not only involves application of fertilizer and irrigation, which are proven as an effective way to boost rice yield, but also better farming practices. For instance, under the program of the system of rice intensification (SRI), various rice cultivation techniques with less use of modern inputs and inexpensive method of planting in relatively dry area could result in an average yield of 3.6 ton/ha, while under a similar situation the yield with traditional farming practice is only 2.4 ton/ha (CEDAC 2008).

Table 2: Fertilizer use in Cambodia

	Wet season paddy		Dry season paddy	
	2004	2007	2004	2007
Share of plots (total number of plots in both seasons = 100)	86.8	84.1	14.3	15.9
Share of total cultivated land (total cultivated area in both seasons = 100)	60.9	79.2	10.8	20.7
In paddy plots (total paddy plots = 100)				
Share of plots using fertilizer	77.5	76.8	81.5	86.9
Share of area using fertilizer	76.9	78.5	87.2	93.5
Average fertilizer expense (Riel/ha)	101,426	84,871	148,265	222,666
Average plot area (ha)	0.9	0.9	1.0	1.3
International urea price ($/ton)*	200	415	200	415
Farmer price ($/ton)**	350	600	350	600
Average exchange rate (Riel/$)***	4021	4032	4021	4032
Calculated fertilizer use (kg/ha)	72.1	35.1	105.4	92.0

Note: Fertilizer use in quantity is not reported in the survey. * is drawn from IFDC (2008); **is from CDRI (2008) in which urea price was $350-$510 per ton, and DAP $450-$1,080 in provincial markets in 2007; and *** is from IMF (2009). Source: Authors' calculation from CSES 2004 and 2007.

While great potential exists in Cambodian rice production, to realize such potential, the country needs to overcome a series of constraints. In the literature, inadequate fertilizer use and underdeveloped irrigation facilities are seen as the most binding constraints. For example, a survey conducted by the Economic Institute of Cambodia (EIC) reveals that for a majority of farmers the top three factors affecting crop yields are lack of irrigation network, obsolete tools, and counterfeit and high cost of fertilizer (Lim 2006a). CDRI (2008) and Tong (2010) also confirm the importance of fertilizer and irrigation for crop production.

Fertilizer is actually widely used by a majority of rice farmers in Cambodia, and CSES 2004 and 2007 report that 77 to 78 percent of wet season and 87 to 94 percent of dry season paddy area received chemical fertilizer (Table 2). However, the quantity of fertilizer per hectare is low. Calculated from CSES data, together with an estimation of average fertilizer price paid by farmers, fertilizer use was about 72 and 105 kg/ha for wet and dry season paddy in 2004, respectively. The amount of fertilizer application per hectare further decreased in 2007 due to the sharp increase in fertilizer price. The average amount of fertilizer use in Cambodia is below the nationally recommended rate (Blair and Blair 2010) and is significantly lower than that in neighboring countries. According to FAO (2010), farmers on average applied 221 kilograms of fertilizer in Vietnam and 108 kilograms in Thailand, which share similar soil and temperature conditions with Cambodia.

The Cambodian government provided subsidized fertilizer in the 1980s and 1990s, until the private sector came to the fertilizer market in 1997 at which time the government stopped providing the subsidy. In the recent years higher fertilizer prices have prevented farmers from properly applying a sufficient amount of fertilizer. In a recent survey conducted by EIC, 79 percent of farmers report underused fertilizer, with financial consideration as the main reason (MAFF and MOWRAM 2008). Adulteration is another problem, with the occurrence of nutrient content mismatched with labels. The presence of poor quality or mislabeled fertilizer has made many farmers suspicious of the market, or abstain from it altogether (Schamel and Hongen 2003).

Lack of sufficient irrigation facilities is the other constraint for rice development. The dependence of Cambodian agriculture on rainfall subjects the sector to weather vulnerability. As a result, there exists significant fluctuation in agricultural growth over time, reflecting excessive exposure of producers to production uncertainties. For example it is estimated that more than 130,000 hectares of rice were damaged by the drought and another 40,000 hectares damaged by flooding in 2002 (Hach and Acharya 2002). While potential irrigation area could reach one million hectares in Cambodia (MOWRAM 2003), most irrigation schemes were built in the 1960s and 1970s, and are not functioning well due to poor design and lack of maintenance and financial and technical supports (CDRI 2008).

According to CSES 2004 and 2007, approximately 11.5 percent of wet season rice and 50 percent of dry season rice area was irrigated in 2004 (Table 3). As fuel prices surged and farmers enjoyed favorable weather in 2007, the shares of irrigated area in total rice area fell to 8 percent for wet season paddy and 36 percent for dry season paddy. It is estimated that total irrigated area is about 485,000 hectares, accounting for 19 percent of total cultivated area (MAFF and MOWRAM 2009). According to the Commune Database 2005, only 16 percent of rural households had their paddy field irrigated, while the remaining 84 percent of farmers relied on the rain for their farmland (Phyrum 2007).

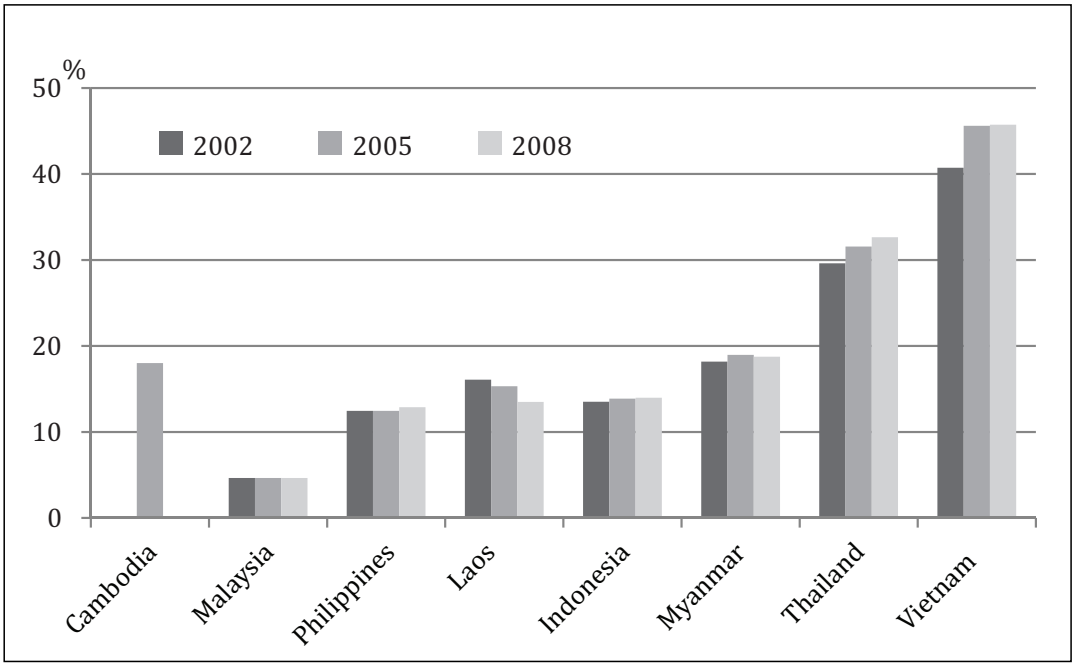
Table 3: Irrigation in Cambodia

	Wet season paddy		Dry season paddy	
	2004	2007	2004	2007
Share of plots using irrigation (%)	14.9	9.4	40.9	38.4
Share of area using irrigation (%)	11.5	8.1	50.1	36.0

Source: Authors' calculation from CSES 2004 and 2007.

Irrigation coverage in Cambodia is below many countries in Southeast Asia (Figure 4). According to government estimates (MAFF and MOWRAM 2008), approximately 18 percent of arable land in Cambodia is irrigated, while according to FAO (2010), the irrigation share of total arable land is 19 percent in Laos, 33 percent in Thailand, and 44 percent in Vietnam. Moreover, most of the irrigation systems are in a state of severe deterioration and only 20 percent of the irrigation schemes are fully functional (MAFF and MOWRAM 2009).

Figure 4: Irrigation in Southeast Asia (share of irrigated area in total arable area, %)



Note: According to FAO (2010), share of irrigated land in total arable land is about 5 percent in Cambodia, which is substantially lower than the government's estimate that is used in the figure for 2005.
Source: Authors' calculation from FAOSTAT (2010).

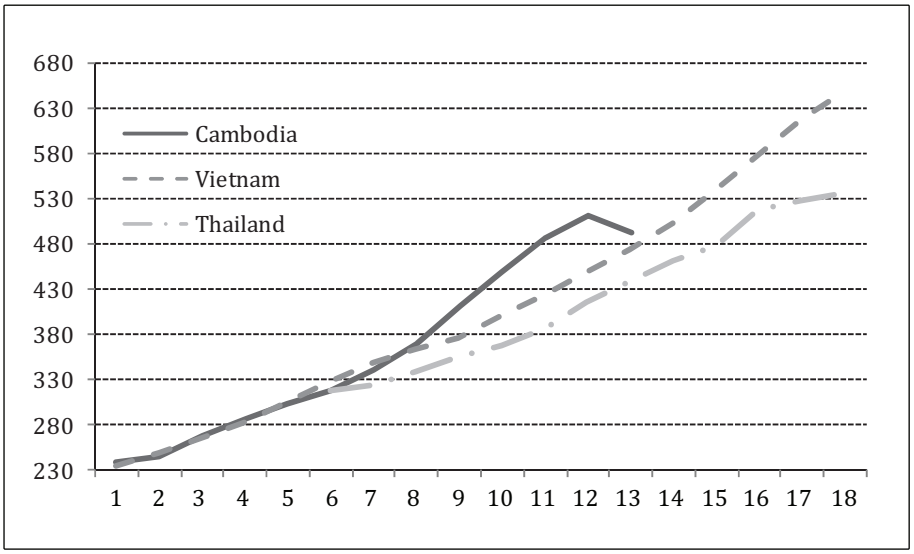
5. Rice in Broad Agricultural Development Strategy

While rice will continue to play an important role in Cambodia's future agricultural growth, it is necessary to put the rice sector in a broad development context to identify better options for its further development. Rice played a similar important role in the economic development process in Thailand in the early 1960s and 1970s and Vietnam in the 1990s as it does in Cambodia today. A comparison between Cambodia's present conditions and a similar development stage in Thailand's and Vietnam's past seems to be helpful in recognizing practical options for Cambodia's rice sector.

We chose 1997 as an initial year for Cambodia and then chose the years in which Thailand and Vietnam had a similar level of per capita income as that in Cambodia in 1997 for comparison. The year for Vietnam is 1991, when its per capita income, measured by constant 2000 US dollars, was close to that in Cambodia in 1997. Data to show a similar level of per capita income in Thailand is not available, so we chose the earliest year (1960) in which Thailand's income data is available in the World Development Indicator. In this year (1960) Thailand's per capita income already reached $317, a level that Cambodia reached in 2002. Figure 5 presents the per capita GDP comparison among these three countries. For comparison purpose, the first year in the figure represents 1997 for Cambodia and 1991 for Vietnam, while the graph for Thailand starts at the 6th year, which represents 2002 for Cambodia and 1960 for Thailand.

As shown in Figure 5, ignoring the global recession effect in 2009, Cambodia's recent growth, measured by per capita income, has been more rapid than that of both Thailand and Vietnam when they started at a similar income level in the past. Starting at per capita income of $239 in constant 2000 US dollar in 1997, Cambodia reached per capita income of $370 in 2004 (in 7 years) and $511 in 2008 (in 11 years). It took a similar time period for Vietnam to increase its per capita income from $235 in 1991 to $364 in 1998, while it took more time (13 years, until 2004) for the country to achieve a per capita income level of more than $500, which Cambodia took 11 years to achieve. Obviously, without the recent global recession, along its recent growth trends Cambodia would have achieved more rapid growth than Thailand in the 1960s and in Vietnam in the 1990s and early 2000s. While the speed of the growth recovery in Cambodia after 2009 is unknown, it is generally agreed that the country's economy will soon come back to its pre-crisis growth momentum. ADB (2010) forecasts a GDP growth rate of 5 percent for 2010 and 6 percent for 2011. If such growth recovery occurs soon, then the gap in per capita GDP between Cambodia and Vietnam would likely decrease in the next decade. While the growth recovery in Cambodia may not rely heavily on rice—which has been less affected by the global recession than the Cambodian garment and tourist sectors—agriculture, particularly rice, is still important in its future growth in many respects. To help understand the role of agriculture in the future, we also conduct a comparison between Cambodia and its neighboring countries in terms of economic structural transformation.

Figure 5: GDP per capita in constant 2000 US dollars

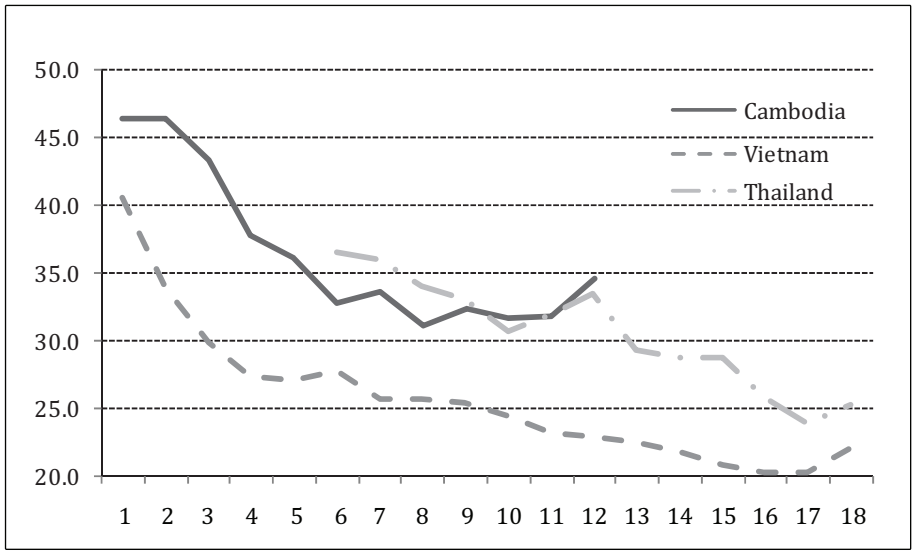


Notes: The value of x-axis is: 1 for 1997 and 13 for 2009 in Cambodia, 1 for1991 and 18 for 2008 in Vietnam, 6 for 1960 and 18 for 1972 in Thailand. Source: WDI 2009.

Both Thailand and Vietnam exhibited a similar economic structure in their earlier stage of development as Cambodia has in recent years. However, as shown in Figure 6, in the early period, the share of agriculture in Cambodia's economy was higher than that it was in the other two countries in their past when they had a similar income level as that in Cambodia in 1997. Cambodia's agricultural sector accounted for 46.3 percent of total GDP in 1997 when its per capita income was about $240. At an income level of $235 in 1991, Vietnam's agricultural share of GDP was 40.5 percent. Although the speed of structural change measured by the declined agricultural share of GDP in Cambodia between 1998 and 2002 is comparable with that in Vietnam between 1992 and 1996, the initial conditions in the economic structure at the similar per capita income level are quite different between the two countries. However, when Cambodia reached per capita income of $320 in 2002, the level that Thailand achieved in 1960, the share of agriculture in GDP was higher in Thailand (36 percent) in 1960 than that in Cambodia (32 percent) in 2002. In the next seven years after 2002, the share of agriculture in Cambodia's GDP was very close to that of Thailand in the similar seven years after 1960. While in Vietnam the agricultural share of GDP fell below 30 percent at per capita income of $280, Thailand started to have a declining agricultural GDP share after the country reached a per capita income of $440.

The more significant structural changes in Thailand's economy started in early 1970s when its income level passed $500 per capita. Again, the world food price surge in 2008 and the following global recession have significantly affected the structural transformation in Cambodia. It seems reasonable to predict that the role of agriculture in Cambodia's next 10 years will be relatively more important than in the two neighboring countries in the past at a comparable per capita income level not only because of differences in the initial conditions, but also due to the unprecedented recent global recession. Reduced import demand from developed countries due to the recession has affected and will continue to affect the growth in Cambodia's export-oriented manufacturing and tourist sectors in the next years.

Figure 6: Share of agriculture in GDP in the three countries (%)

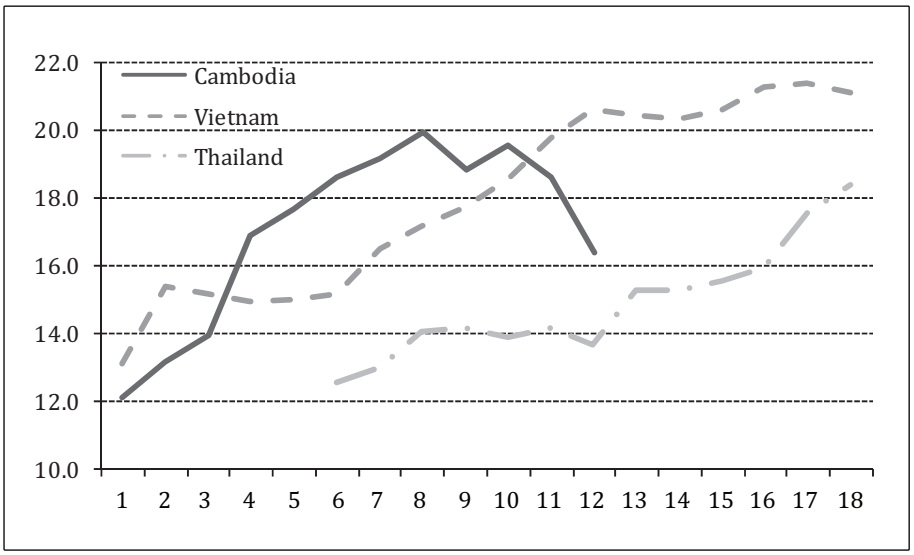


Notes: The value of x-axis is: 1 for 1997 and 13 for 2009 in Cambodia; 1 for 1991 and 18 for 2008 in Vietnam; and 6 for 1960 and 18 for 1972 in Thailand. Source: WDI 2009.

The manufacturing share of GDP also shows a similar pattern between Cambodia today and Thailand and Vietnam in their early periods of transformation. Led by garment exports, Cambodia enjoyed a rapid growth in its manufacturing sector and the share of this sector in the economy was consistently higher in Cambodia than that in Vietnam and Thailand at the similar income level in

their past. However, this transformation trend has been reversed by the recent global recession (Figure 7). Obviously, such unfavorable external conditions will continue to challenge the growth process of Cambodia and hence will put more pressure on the agricultural sector to lead the economic growth.

Figure 7: Share of manufacturing in GDP in the three countries (%)



Notes: The value of x-axis is: 1 for 1997 and 13 for 2009 in Cambodia; 1 for 1991 and 18 for 2008 in Vietnam and 6 for 1960 and 18 for 1972 in Thailand. Source: WDI 2009.

Competitiveness of Rice Sector

We now turn to the rice sector for a comparison of the three countries. Table 4 reports the average yield in Cambodia, Thailand and Vietnam. While current rice yield in Cambodia is lower than that of both countries, the yield gap between Cambodia and Thailand is modest. The average rice yield of 2.54 ton/ha in Cambodia in 2006-08 is almost half of Vietnam's yield, but the yield difference between Cambodia and Thailand is only 10 percent. A longer period rice yield trend is presented in Figure 8 in which we compare the rice yield in the three countries starting at the period when they have a similar per capita income level. In the period of 13 years between 1997 and 2009, Cambodian rice yield increased from 1.8 tons/ha to 2.8 tons/ha, growing at 4 percent average per year. This growth is faster than Vietnam in a same length of time between 1991 and 2008 (3.1 percent per year) and Thailand in a much longer period of 48 years between 1961 and 2008 (1.2 percent). While Vietnam is often used as an example to argue the yield potential in Cambodia, the significant difference in the initial conditions causes the big departure in rice yield between these two countries. Vietnam had reached Cambodia's current rice yield level as early as in mid 1980s and doubled this level (reaching 5 ton/ha) in the next 25 years by 2007. If rice yield in Cambodia continues to grow at its recent trend of 4 percent per year, Cambodia will reach 5 ton/ha of rice yield in the next 14 to 15 years, i.e., with even fewer years to achieve what Vietnam achieved in 25 years.

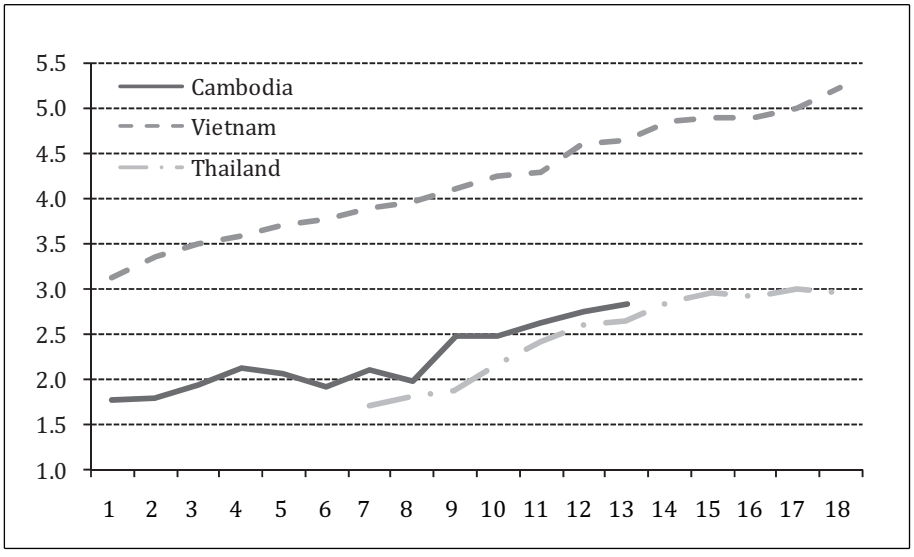
Table 4: Rice Yield in Cambodia and Neighboring Countries, 2000-2008

	Thailand	Cambodia	Vietnam
Yield 2006-08 average (tons/ha)	2.74	2.54	4.89
Land-labor ratio (ha/person)	0.96	0.81	0.33
Input use 2006-08			
Fertilizer (kg/ha)	108.2	34-68	220.9
Irrigation (% of agricultural area)	33	20	46
Tractor (per ha)	14.2	0.6	24.9
Trade 2005-07average			
Export quantity (thousand tons)	6483	2	4817
Export value (million $)	2359	1	1391
Export price 2006-07 average ($/ton)	364	517	289

Source: Authors' calculation from FAOSTAT (2010) and CSES 2004 and 2007.

While it is possible for Cambodia to follow the Vietnam's path to design its rice development strategy, Thailand's experience should be paid more attention. As shown in Figure 8, Thailand did not significantly increase its rice yield in a period of 48 years between 1961 and 2008. In 1961, the average Thai rice yield was 1.7 ton/ha, a level that is even lower that in Cambodia in 1997. Only in recent years has the rice yield in Thailand reached 3 ton/ha, a level reached by Vietnam in the late 1980s. On the other hand, as the largest rice exporter, Thailand's leading position in the world market was never challenged in this period. Between 1961 and 2007, Thai rice exports increased by 16 times, with an average annual growth rate of 6.4 percent. Even in the 25 years since Thailand has become a middle income country, rice exports continue to grow at an average growth rate of more than 4 percent. Obviously, Thailand's competitiveness in the world rice market is less related to yield increase than area expansion and yield improvement.

Figure 8: Trend of rice yield in the three countries, tons per hectare



Notes: The value of x-axis is: 1 for 1997 and 13 for 2009 in Cambodia; 1 for 1991 and 18 for 2008 in Vietnam; and 7 for 1961 and 18 for 2008 in Thailand. Source: Authors' calculation from FAOSTAT (2010).

We emphasize Thailand's experience in rice development because of the similarity of natural resource conditions between Cambodia and Thailand. Both Thailand and Cambodia are relatively land abundant countries by regional standards (see Figure 3 in Section 4). While insufficient fertilizer application is named in the literature as a major factor constraining yield growth in Cambodia (see the discussion of such literature in Section 4), the level of fertilizer application per hectare was also low in Thailand in the past. Even today, the average use of 108 kilograms per hectare in Thailand can still be called a low level, if we compare it with 220 kilograms per hectare in Vietnam. Low irrigation coverage is the second factor argued to affect Cambodia rice productivity, and this is another similarity with Thailand: the proportion of irrigated land in Thailand is only 33 percent, much lower than Vietnam's 46 percent.

Drawing from Thailand's experience, the focus of a rice strategy in Cambodia should be to increase rice competiveness instead of only emphasizing productivity measured by rice yield. While rice is a relatively homogenous product, its different varieties and qualities carry a significant price premium in the export market. To improve Cambodia's rice competiveness in the market, we must fully understand the actual comparative advantage of Cambodia's rice sector. From the supply side, the unique comparative advantage of Cambodia's rice sector lies in its relatively ample and unused arable land. While lower use of fertilizer may affect rice yield and hence land productivity, fertilizer used in Cambodia comes from imports, and the related high input costs may not make it profitable for farmers to adopt a technology requiring intensive use of fertilizer. Such a technology is unlikely to allow Cambodia to compete with other countries in the region by offering a lower price.

The second comparative advantage of Cambodia is its rice quality. It is well known that Cambodian rice varieties cultivated for export receive a high price premium due to better taste and a quality preferred by high-value consumers (Table 4). This is especially true for the traditional wet season rice varieties grown by most of the rural poor in Cambodia, which usually fetches higher prices than high-yield dry season varieties for its higher quality and is better fitted with consumer preference. Targeting the diverse requirements of foreign markets is a reason for Thailand's competiveness in the world rice market. High-quality Thai rice often targets developed country markets or high-value consumers in developing countries, as these consumers are willing to pay a higher price for better quality and better-tasting varieties. On the other hand, Thailand has increased rice exports to African countries in recent years, using low price to penetrate many African markets.

Successful growth in Thailand's rice sector suggests that although yield is not very high, Thai rice can still compete in the international market not by getting the highest yields, but by keeping cost low or by providing high quality varieties and fetching high prices. On the other hand, Vietnam is mostly focused on delivering low-quality rice in large volumes. Given that Cambodia has become a rice export country and national food security is not the only factor for rice development in the future, the focus of Cambodia's rice development strategy should be to increase Cambodia's rice competiveness by exploring export opportunities such as targeting niche markets and cultivating different varieties for different types of consumers in foreign countries. Increasing rice competiveness will offer Cambodia an opportunity to allow rice to continue lead its agricultural growth.

Simulation of Cambodian rice production

Based on the comparative advantage discussed above, we simulate the production outcome of possible area expansion or yield increase through increased use of inputs. Assuming current technology, i.e., without increases in the use of modern inputs such as fertilizer, and with given elasticity of output with respect to the increases in land, a 10 percent area expansion for wet season rice (an equivalent of 211 thousand hectares) increases wet season rice output by 193,180

tons (Table 5, last column). If dry season rice area increases by 10 percent, which is equivalent to additional 37 thousand hectares to the current level, dry season rice output increases by 51,578 tons.

We then simulate the possible output increase through increased use of fertilizer. The elasticity of rice output response to increased use of fertilizer and irrigation is estimated by Yu *et al.* (2010) and reported in Table 5, column (5). The fertilizer use level and proportion of irrigated land in Thailand are chosen as targets to design the simulation. If average fertilizer use is to be increased to Thailand's level of 108.2 kg/ha, it is equivalent to a 50 percent increase in wet season fertilizer use and 10 percent increase in dry season. This is expected to increase wet season rice production by 141,420 tons and 16,785 tons for dry season rice. We also simulate rice output increase through increased irrigation. By doubling wet season irrigation coverage from 11.5 percent to 23 percent and increasing dry season irrigation from 50.1 percent of 55.1 percent, irrigation coverage in Cambodia will reach 33 percent of Thailand's level. With such increases in irrigation, rice output can increase by 49,441 tons in wet season and 8823 tons in dry season.

Table 5: Simulation results of rice output increase by area expansion and input intensification

Season	Current land or input use	Current output (000 ton)	Land expansion or input increase (% of current level)	Simulated increases in land or input use	Output elasticity w.r.t. land/ input	Output increase (ton)
	(1)	(2)	(3)	(4)	(5)	(6)
Area[1]						
Wet	2110	2828	10	211	0.683	193,180
Dry	373	827	10	37	0.625	51,678
Fertilizer use[2]						
Wet	72.1	2828	50	108.2	0.100	141,420
Dry	105.4	827	10	115.9	0.203	16,785
Irrigation[3]						
Wet	11.5	2828	100	23.0	0.152	49,441
Dry	50.1	827	10	55.1	0.213	8823

Note: 1 Area for columns (1) and (4) is measured in 1,000 ha
2 Fertilizer use for columns (1) and (4) is measured in kg/ha
3 Irrigation for columns (1) and (4) is measured in percentage of total cultivated areas.
Source: Authors' calculation from CSES 2004, Yu *et al.* (2010), and FAO (2010).

The simulation results further confirm the previous discussion that the comparative advantage of Cambodia rice lies in its abundant land resources; and input intensification might not be an effective way to boost rice production. While the magnitude of the possible output increase through area expansion in wet season is similar to the outcome from the combination of increased use of fertilizer and irrigation (to reach Thailand's current fertilizer application and irrigation levels), the costs between these two options can be very different both for the government's public investment and for farmers' own spending. Given the estimated elasticity, fertilizer use is unlikely to be profitable to farmers if world price for fertilizer keeps at its recent high level.

6. Future Research

The path of Thailand or Vietnam?

In the literature, the rice export structure in Cambodia is seen to be weak and conventional rice production in Cambodia is unlikely to be able to compete with that of neighboring countries (EIC 2006). Average rice yield in Cambodia is only about half of Vietnam, and the export volume is less than 1 percent of Vietnam (Table 4). This leaves little room for Cambodia to compete with Vietnam in the low and medium price rice market. In addition, the relative high land-labor ratio renders it costly for Cambodia to take the path of Vietnam to focus on input-intensive, high yield varieties.

On the other hand, Cambodia shares a common feature with Thailand of relative land abundance. Another similarity between the Cambodian and Thai rice sectors is that their specialty rice is popular in international market and receives favorable prices. Therefore, a study focusing on the alternative paths of Cambodia to increase its competiveness in rice market is required as one important component of the country's rice sector development strategy. Our current study only provides a rough cross-country comparison between Cambodia and Thailand, and Cambodia and Vietnam. Future studies should be more specific to identify the comparative advantages of Cambodia in rice production, including understanding the demand of niche markets, segmenting market by quality and consumer preference, examining local agronomy conditions, and exploring new markets.

Going beyond yield

Currently the Cambodian government and international organizations have paid more attention to increasing rice yield, with less attention to improving rice quality to increase Cambodia's rice competiveness. Since Cambodia reached food self sufficiency at the national level in the late 1990s, a continuous emphasis on increasing amount of rice production might result in an oversupply of rice and lost opportunity for planting higher-value rice varieties and other high-value crops. This could cause the country to miss market opportunities in high value products which put more weight for quality rather than quantity. More research needs to pay attention to how Cambodia can exploit its comparative advantage by exporting rice with higher value addition. Improving the quality of local rice could reduce the need to import high quality rice and fetch high prices in the international market.

Possibly diversified rice includes: glutinous rice (3 times the price of typical wet season rice) and aromatic rice (30-100 percent higher price) (ACI and CamConsult 2006). A good example of high quality Cambodian rice is the high quality organic 'Neang Malis' aromatic rice from Battambang province, which is exported to niche markets in Europe and Hong Kong. Generally, this special rice receives a $100 per ton of price premium over best Thai Jasmine varieties and more than twice the price of domestically marketed rice (MAFF and MOWRAM 2008). The success of high quality rice underscores the importance of targeting specific high value markets with a quality product, for which there is a demand. The gross income from growing aromatic varieties is about 20 percent, or $18/ha, higher than growing typical wet season rice, mostly due to a 40 percent price premium from aromatic varieties is (ACI and Camconsult 2006). Organic rice is identified as specialty rice for niche market, which can grab 20-60 percent price premium in supermarkets (McNaughton 2002).

However, there is little research on specialty rice and its associated production constraints in the country. Therefore, more research needs to be conducted in this area, including research on Thailand's experience in promoting agricultural R&D to improve the quality and taste of rice

varieties. Research is also required on evaluating the cost and returns of public investment in different rice development focuses. It is important to examine the trade-offs between different rice development goals, such as yield increase vs. diversified and high quality rice development. Such research needs to take into consideration the impact of different rice development strategies on poverty, food security and nutrition at the household level.

Diversification into other crops

Research on crop diversification is also important. While Thailand has kept its leading role in world rice market, it has also developed into many other crops for export such as maize in the early years and cassava even until recent years. Cassava and maize are often upland crops, which serve both as staples for the poor to support their food security and as cash crops for exports. Upland represents 35 to40 percent of Cambodia's total arable land, and the population density is still much lower in upland regions. Due to significant population growth and severe landlessness in the lowlands, combined with ongoing demining activities, upland areas have become the major target area for migrating landless young farmers from the lowlands (Munda and Bunthanb 2005).

Fast growth in maize and cassava production has been observed in Cambodia in recent years. Increases in the planted areas of the two crops, although from a relatively smaller base, are impressive, indicating their potential for generating more income to farmers and for supporting food security in some areas. Moreover, the majority of maize and cassava outputs are targeted to foreign markets: more than 90 percent of production is exported.

Table 6: Revenues, costs, income, and margins for different crops

		Revenue	Cost			Net return	Margin
			Materials	Labor	Total		(return / revenue)
			000 Riel/ha				%
Wet season rice	Battambang	885	290	288	577	308	34.8
Aromatic wet season rice	Kampong Speu	1360	610	380	990	370	27.2
Dry season rice not intensified	Kampong Speu	1290	755	380	1135	155	12.0
Dry season rice intensified	Svay Rieng	2600	1280	325	1605	995	38.3
Cassava	Battambang	6590	1757	1271	3028	3561	54.0
Cassava	Banteay Mean Chey	6050	884	1480	2364	3685	60.9
Cassava	Kampong Cham	3939	395	1001	1396	2543	64.6
Maize	Battambang	3075	150	371	221	2704	87.9
Maize	Banteay Mean Chey	2325	574	861	287	1464	63.0
Maize	Kampong Cham	3080	957	1489	532	1591	51.6
Cabbage	Kampong Thom	7550	1900	640	2540	5010	66.4
Convolvulus	Svay Rieng	12,000	388	2375	2763	9237	77.0

Source: Authors' compilation from ACI and CamConsult (2006) and MAFF (2008).

Fruits and vegetables also offer opportunities to Cambodia for income generation. Fruits and vegetables can generate more income from given land area. For example, the prices of vegetables are $400/ha for cauliflower, $1400/ha for lettuce, and $3000/ha for black pepper, compared to US$100-300/ha for rice (MAFF and MOWRAM 2008). As shown in Table 6, horticultural production can lead to net return 16 to 30 times higher than the return of paddy produced during wet season.

There is strong demand for fruits and vegetables in Cambodia. FAO (2010) reports that imported fruits and vegetables account for 70 percent of Cambodia consumption, amounting to about $3 million a year. Cambodia has huge potential to produce fruits and vegetables not only for import substitution but also for exports. Currently only approximately 20 percent of rural households engage in some vegetable production, and production is limited to dry season between December and March. As a result, the volume of imported vegetables in wet season is 50 percent more than that in dry season.

Agricultural diversification is an important research topic. Under this topic, more attention should be paid to the experiences and lessons of other Southeast Asian countries. Such research should focus not only on production, but also consumption diversification, as experiences from other Southeast Asian countries suggest that diversified food production can lead to consumption diversification, which has helped to improve rural households' nutrition status. The relationship between production diversification, consumption diversification, and nutrition improvement deserves more detailed study in the future.

In summary, developing an evidence-based agricultural strategy requires research to better understand Cambodia's comparative advantage and the available options to explore this advantage. It also requires a better understanding of the interactions between different growth options and growth outcomes in terms of income generation for the poor and food security and nutrition improvement. Finally, it requires prioritization and sequencing of public investment to promote agricultural growth.

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Appendixes

Table 1: Economic comparison between Cambodia and neighboring countries

Indicator	Cambodia	Laos	Thailand	Vietnam
GDP (constant 2000 billion US$)	7.3	3.1	173.9	58.8
GDP growth (annual %)	9.8	6.9	5.2	7.7
GDP per capita (constant 2000 US$)	492	496	2566	674
GDP per capita growth (annual %)	8.0	5.1	4.1	6.3
Agricultural share of GDP (%)	34.6	34.7	11.6	22.1
Agriculture, value added (annual % growth)	5.6	0.4	2.5	3.9
Exports of goods and services (% of GDP)	65.3	32.7	76.6	78.2
Exports of goods and services (annual % growth)	14.0	10.2	7.3	13.4
Manufacturing, value added (% of GDP)	16.4	9.3	34.9	21.1
Manufacturing, value added (annual % growth)	12.9	-4.1	6.6	11.9
Population (million)	14.8	6.3	67.8	87.3
Population growth (annual %)	1.6	1.7	1.0	1.3
Poverty rate at $1.25 a day (PPP) (%)	25.8	44.0	2.0	21.5

Note: GDP and population are for 2009, agricultural and manufacturing shares of GDP are for 2008, and Cambodian poverty rate is for 2007. All growth rates are 2000-08 average.
Source: World Development Indicator (World Bank 2009).

Table 2: Summary of government targets for rice

	2005	2006	2007	2008	2010	2015	2020
NSDP 2006-2010							
Rice production (million tons)	4.17				5.5		
Rice yield (ton/ha)	1.97				2.4		
Share of irrigated rice area (%)	20				25		
Mid-term Review NSDP 2006-2010							
Rice production (million tons)	5.98	6.26	6.72	6.98	7.25		
Rice yield (ton/ha)	2.48	2.49	2.62	2.6	2.8		
Irrigated area (thousand ha)	632	721	773	827	867		
Share of irrigated rice area (%)	26.6	29.6	30.9	33.1	34.7		
SAW 2006-2010							
Rice production (million tons)	4.17				5.5		
Rice area (million ha)	2.37				2.5		
Irrigated crop area (thousand ha)	586				650		
Share of irrigated rice area (%)	24.7				26.0		
Share of supplementary irrigated crop area in wet season (%)	20						
Share of fully irrigated crop area in dry season (%)	7-8						
Share of irrigated crop area (%)					25		
SAW recommended share of irrigated crop area (%)					20		
CAASP							
Rice production (million tons)			6.24		6.05	6.13	7.50
Rice area (million ha)			2.5		2.5	2.5	2.6
Rice harvested area (million ha)			2.52		2.43	2.45	2.50
Rice yield (ton/ha)			2.48		2.49	2.50	3.00
Available rice after 13% seed reserve and post harvest loss (million tons)			5.43		5.26	5.33	6.53
Milled rice under 64% milling rate (million tons)			3.47		3.37	3.41	4.18
Food requirement (million tons)			1.91		2.00	2.11	2.27
Consumption/person (kg)			143		143	140	140
Population (million, annual growth rate 1.54%)			13.4		14.0	15.1	16.2
Rice surplus (milled rice)			1.56		1.37	1.30	1.90

Source: Author's Compilation based on government documents.

Table 3: Rice Paddy Production in Cambodia, 2000-2008

Year	Production 000 tons	Cultivated area 000 hectares	Yield Ton/hectare
1994	2222	1700	1.31
1995	3413	1900	1.80
1996	3286	1950	1.69
1997	3413	1930	1.77
1998	3492	1960	1.78
1999	4040	2070	1.95
2000	4025	1903	2.12
2001	4100	1980	2.07
2002	3822	2000	1.91
2003	4698	2240	2.10
2004	4175	2100	1.99
2005	5986	2415	2.48
2006	6263	2516	2.49
2007	6468	2525	2.56
2008	6706	2600	2.58
Average			
1994-1997	3084	1870	1.6
1998-2002	3896	1983	2.0
2003-2007	5518	2359	2.3
Annual growth rate %)			
1994-1997	13.3	4.2	8.8
1998-2002	2.0	0.0	2.0
2003-2007	11.0	4.3	6.4
1994-2007	6.5	2.5	3.9

Source: Authors' calculation from USDA Production, Supply and Distribution Online (2008).