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Agricultural Development and Climate Change: The Case of Cambodia

ROS Bansok, NANG Phirun and CHHIM Chhun

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Responsibility for ideas, facts and opinions presented in this research paper rests solely with the authors. Their opinions and interpretations do not necessarily reflect the views of CDRI.

CDRI
☞ 56, Street 315, Tuol Kork
✉ PO Box 622, Phnom Penh, Cambodia
☎ (+855-23) 881-384/881-701/881-916/883-603
🖷 (+855-23) 880-734
E-mail: cdri@cdri.org.kh
Website: http://www.cdri.org.kh

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Acronyms

ACLEDA	Association of Cambodian Local Economic Development Agency
ADB	Asian Development Bank
AIC	Agricultural Inputs Company
ASSDP	Agricultural Sector Strategic Development Plan
CARDI	Cambodia Agricultural Research and Development Institute
CDRI	Cambodia Development Resource Institute
CMDG	Cambodia Millennium Development Goal
Danida	Danish International Development Agency
ELC	Economic Land Concession
FAO	Food and Agriculture Organisation
FiA	Fisheries Administration
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
MAFF	Ministry of Agriculture, Forestry and Fisheries
MFI	Microfinance Institution
MIME	Ministry of Industry, Mines and Energy
MoE	Ministry of Environment
MOWRAM	Ministry of Water Resource Management and Meteorology
MPWT	Ministry of Public Works and Transportation
MRC	Mekong River Commission
NAPA	National Adaptation Programme of Action
NGO	Non-government Organisation
NIS	National Institute of Statistics
NOAA	National Oceanic and Atmospheric Administration
NPRD	National Programme for Rehabilitation and Development
NSDP	National Strategic Development Plan
NTFP	Non-timber Forest Product
PDoE	Provincial Department of Environment
RGC	Royal Government of Cambodia
RS	Rectangular Strategy
SAW	Strategy for Agriculture and Water

SEDP	Socio-economic Development Plan
TWGAW	Technical Working Group on Agriculture and Water
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USD	United States Dollar
WRMRCDP	Water Resource Management Research Capacity Development Programme

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Executive Summary

Cambodia's economy is largely based on the agricultural sector and this sector is the main water user in Cambodia (Wokker *et al*. 2011a: 1-3). Several studies acknowledge that wet season rice farming is crucially important for livelihoods. With such farming being historically dependent on rainfall, the majority of lowland farmers grow just one crop a year. In recent years, increasingly irregular rainfall, generally associated with climate change, has adversely affected crop production. As a result, water shortages have led to conflicts among farmers which have so far proved difficult to solve (Nang *et al*. 2011: 37-39).

Rice production significantly contributes to national food security and poverty alleviation. Other major crops, namely maize, cassava, soybeans, peanuts and rubber are also important sources of income generation and livelihood improvement. As of 2007, the overall poverty line for Cambodia has decreased to 30.1 percent from 34.8 percent in 2004 (World Bank 2009: 27). The agricultural sector has been an important contributor to national development and economic growth and it still provides a key share of GDP compared to other sectors, for instance, industry and services. Moreover, agriculture employs just over 67 percent of the country's total labour force.

The cultivated area, especially rice farming, has expanded over the last three decades from around 1.5 million ha in 1980 to 2.79 million ha in 2010 (MAFF 2011a). Rice production has increased from less than 2 million tonnes in 1980 to approximately 8.25 million tonnes in 2010. Fertiliser use has gradually increased and modern farming equipment, such as tractors, two-wheel tractors, harvesters and threshers, has been slowly introduced, though traditional agricultural techniques and seeds are still widely used. Most rice is grown to meet domestic consumption and market demand. Nevertheless, Cambodia's rice yield is still the lowest among its neighbouring countries in the region. Annual growth in production is a result of the expansion of the cultivated area rather than intensive farming to improve productivity. Largely delineated by access to irrigation, dry season rice farming constitutes only about 14 percent of total rice cultivation even though dry season yields are higher. Average rice yield in 2010 was 2.76 tonnes per ha in the wet season and 4.2 tonnes per ha in the dry season (MAFF 2011a).

All agricultural sub-sectors have made remarkable progress in terms of production, rice in particular. In addition, forest and fisheries resources have made important contributions to economic growth. Forests are important for livelihoods and the environment, but they no longer provide as many benefits as they used to. Expansion of agricultural land has gradually diminished forest areas thus exacerbating pressure on forest ecosystems and local livelihoods. One of the Cambodian Millennium Development Goals (CMDG) addresses deforestation in the National Forest Policy to maintain forest cover of no less than 60 percent of the country's total land area by 2015. Fish is the second staple food after rice, with fisheries captures providing 75 percent of national dietary protein. However, current degradation of wetlands and associated habitats compounded by effects of climate change, especially irregular rainfall and hydrological changes, will likely impact on fisheries resources.

Increasingly frequent natural shocks, i.e. drought, flood and cyclone, can have devastating consequences for agricultural activities, especially rice farming. These events tend to hit the most vulnerable of the rural poor the hardest. Irregular rainfall and associated impacts have caused increased loss of agricultural investment (crops, assets) and human life. Majority of farming still depends on rainfall and most farmers grow just one crop a year. The combination of low productivity, volatile prices and limited access to credit may be a critical constraint to improving local livelihoods. Development of more physical irrigation infrastructure is expected to create more opportunities for intensive farming.

1
Introduction

1.1. Background

This paper focuses on contemporary issues of climate change and agricultural development in Cambodia, drawing on information gathered from literature review, field observations and dialogues, as well as two provincial consultation workshops on technical and policy recommendations. It also reflects on current agricultural practices and agricultural technology in determining potential national production so as to ensure food security and poverty alleviation. This information highlights important considerations for integration in national agricultural development efforts. Further, the potential effects of climate change are carefully considered in the government's policy on national climate change adaptation.

Climate change has already impacted on agricultural production and economic growth around the world. It has become a significantly critical global topic and adaptation strategies to cope with its potential impacts are increasingly being integrated into development policy. These impacts are critical since agriculture[1] makes a particularly significant contribution to the economies, food security and poverty alleviation in most developing countries such as Cambodia[2].

In response, the Royal Government of Cambodia (RGC) has prepared a strategy on climate change adaptation - the National Adaptation Programme of Action (NAPA) endorsed by the Council of Ministers in October 2006 and signed by the prime minister, to address the immediate needs and concerns of those affected at grassroots level and guide the implementation of adaptation initiatives. Extended long dry seasons, irregular rainfall and natural disasters in recent years have affected agricultural activities, especially rice cultivation which is traditionally dependent on rainfall. Rainfall distribution determines the success and size of the harvest and as a result farmers generally only grow one crop per year (Wokker *et al.* 2011b). However, double-cropping (i.e. growing two rice crops on the same plot in the same year) is possible where sufficient irrigation water is available.

Cambodia has a monsoon climate, with a six-month wet season and a six-month dry season. The southwest monsoon brings the rainy season from mid-May to mid-September/ early October. The northeast monsoon flows of dry cooler air from early November to March are followed by hotter air from April until early May. Wet season rice farming generally starts early in the wet season and the crop is harvested six months later. Changes in rainfall pattern might delay wet season rice farming. This would also impact on other crops or rice cultivation in the next season. In addition, a short drought occasionally occurs during the wet season between late July and early August. If this drought is prolonged, it is likely to have significant impact on crops. Farmers recognise that the damage caused to their farming in recent years is associated with climate related issues (irregular rainfall, drought and flood). Local perception

1 Cambodia's economy is largely agrarian; the agriculture sector contributes 30 percent of GDP and employs more than 67 percent of the national labour force (Wokker *et al.* 2011b).

2 Cambodia's land area covers 181,035 km^2 in the southeast part of the Indochina peninsula and lies in the tropics with its southernmost point slightly more than 10^o above the Equator. It shares borders with Vietnam, Thailand and Laos. The capital city is Phnom Penh. The country is bounded on the southwest by the Gulf of Thailand, and has 435 km of coastline. According to the 2008 Census, the population is 13.4 million, 51.5 percent of which is female (NIS 2009). Population growth rate is estimated at 1.54 percent per annum (NIS 2008).

of these changes and market demand have driven more farmers to use new varieties of rice seed, which take less time to reach maturity, and diversify their farming.

As of 2010, Cambodia has 2.79 million ha of cultivated land; 2.39 million ha are under wet season rice cultivation. Average yield of wet season rice is 2.75 tonnes per ha compared to about 4.20 tonnes per ha for dry season rice (MAFF 2011a: 3). Overall policies for agriculture aim at "assuring food security, increasing household income, generating job opportunities through improving productivity and agricultural diversification and trade, as well as protecting natural resources and environment for sustainable development" (MAFF 2011a: 9). Agricultural sector growth, especially rice cultivation, has been increasing annually, both in terms of cultivated land and production. Recognising that irrigation development is a significantly important input to help improve rice productivity, the government has recently renewed efforts to promote water sector development.

1.2. Research Objectives

The core objectives of this study are:

- To aggregate information from in-depth literature review to reflect the magnitude of Cambodia's agricultural development efforts and implications for food security and poverty alleviation;
- To explore climate related issues and their potential consequences for the agricultural sector by looking at different agro-ecological zones. Importantly, information captured by this study could inform the choice of appropriate agricultural technology to mitigate the detrimental effects of natural shocks on agricultural activities;
- To validate the information captured, including on policies, to gain deeper understanding of how farmers are coping with increasingly irregular climate/weather conditions.

Specifically, the study is to collect information and reflect on the current scope of agricultural development efforts in the context of climate change. It intends to provide in-depth insights with a view to food security and poverty alleviation at large, which can feed into policy-oriented adaptation strategies for agricultural development.

2

Methodology and Approaches

The study was implemented by a joint team of researchers from the Natural Resources and Environment and Poverty and the Agriculture and Rural Development Programmes at CDRI. The team prepared a work-plan based on the research design to (1) collect information and data from relevant partners and government institutions, (2) conduct fieldwork through focus group discussions (FGD) and observation, and (3) hold two consultation workshops for stakeholders including officials from government line departments and development partners. The workshops on technical and policy recommendations were held to get more critical inputs, aiming at coping with climate change and agricultural development.

Agriculture and climate change is the main theme of this research. To gain in-depth insights into the situations in Cambodia's different agro-ecological zones, this theme is divided into sub-themes: agriculture (focused on crops); fisheries, forestry and land use; and climate change or natural calamities. These sub-themes were expected to give rise to different sets of data that interact when aggregating the impacts of climate change and agricultural development. Most of the 15 sites, covering 14 provinces, selected for this study are the same as those used in previous research conducted by CDRI[3]. A list of questions to guide the focus group discussions was devised. Specific study locations were marked on a land cover map based on the country's four agro-ecological zones, namely the Tonle Sap Plain, Mekong Plain, Plateau/Mountain Region, and the Coastal Area. The approaches and methods used entailed the collection of secondary data, field dialogues through 15 FGDs (one at each study site), and two consultation workshops at technical and policy-making level with government line department officers and development partners so as to assess the state of practical knowledge, farmers' experiences and major crops in relation to climate change and agricultural development. Information on the sub-themes of fisheries, land use and climate related natural calamities was also gathered during the FGDs. These discussions helped deepen the understanding of the magnitude of development efforts in Cambodia and also reflected the potential contribution and impact of agricultural development in the context of climate change.

Information garnered from the FGDs complemented the literature review as well as information and issues raised during the workshops. The literature review gave critical clues as to which areas to explore further. Specifically, gaps identified in the literature assumed importance for the in-depth study in terms of guiding the FGDs. The research design and methods focused not only on gathering information but also on providing concrete policy implications in the context of the present state of Cambodia's agricultural technology for improving agricultural production to ensure national food security.

To understand the general context of the state of agriculture and climate change in Cambodia, the literature was comprehensively reviewed with a particular focus on policies that have implications for agriculture and climate change. As previously noted, several significant areas such as crop cultivation, especially the major crops (rice, maize, cassava, rubber), fisheries, forestry, land use and climate change were examined. This allowed the analyses of significant constraints and other factors in relation to natural shocks associated with climate

3 These sites offer insights into different aspects of the study themes in four different agro-ecological zones. Also, the research team can use and build on the existing network with local authorities and key people in the communities who are familiar with CDRI's work.

change, through which key drivers of agricultural adaptation, integration and diversification of agricultural inputs such as practical knowledge, technology and mechanisation, and other factors that contribute to agricultural development and climate change adaptation in the country could be identified.

Figure 1: Agro-ecological Zone Map of the Study Sites

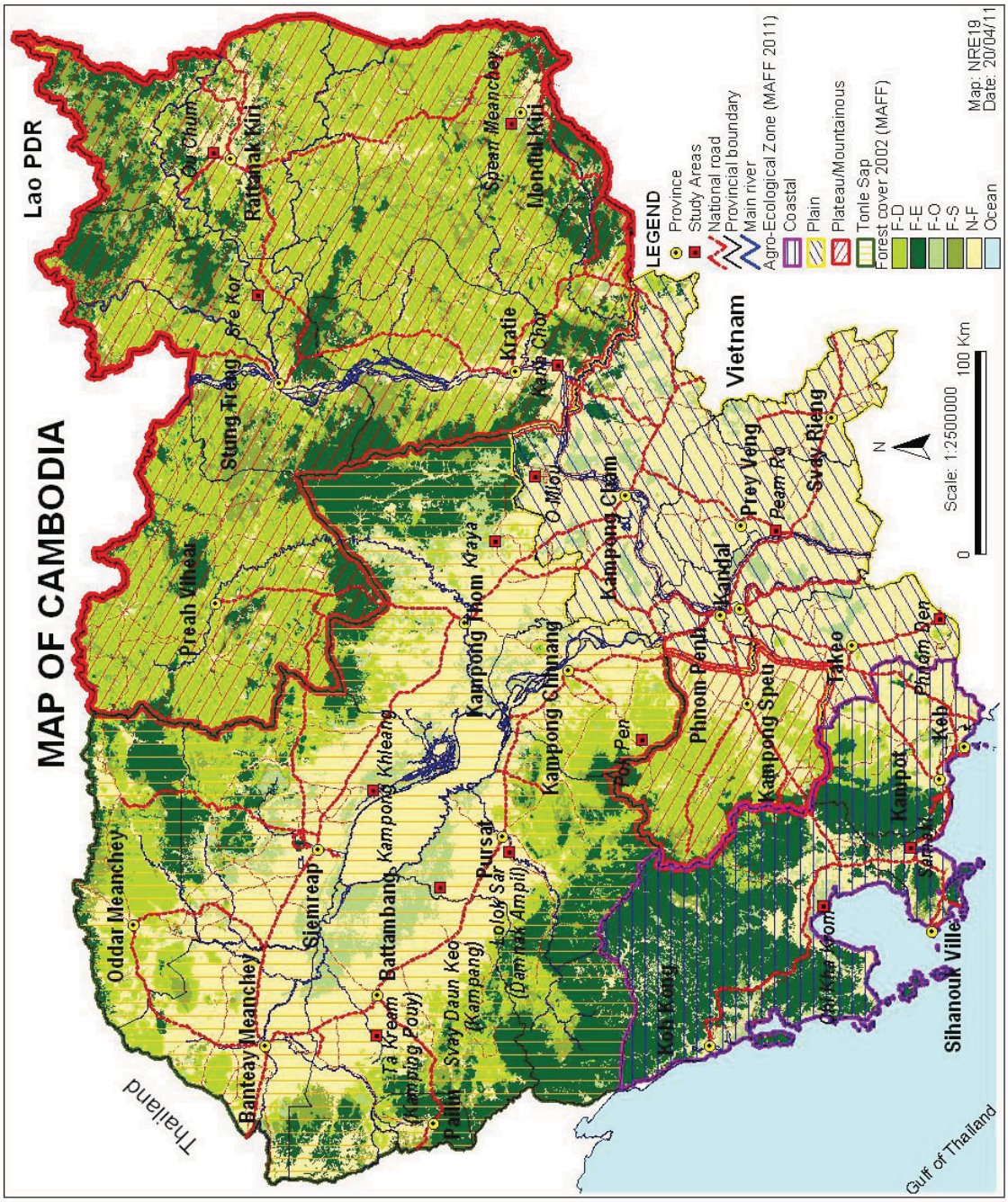


Table 1: Research Themes in the Study Sites by Agro-ecological Zone

No.	Agro-ecological zone		Study site			Research topic/theme
	Zone	No. of FGDs	Province	District	Commune	
1	Coastal Area	2	Sihanoukville Koh Kong	Prey Nop Sre Ambel	Samaki Chi Khor Krom	Fisheries, agriculture + saltwater intrusion and land use and rainfall, natural shocks, and livelihood related issues, market and credit accessibility and infrastructure.
2	Tonle Sap Plain	6	K.Chhnang K. Thom Pursat Pursat Battambang Siem Reap	Teuk Phos Santuk Sampov Meas Bakan Ba-Nan Soth Nikum	Toul Khpus Kra Yea Lolok Sar Svay Daunkeo Takream Kompong Khleang	Agriculture, fisheries + forestry + land use, irrigation (water) and climate related issues, livelihoods market credit accessibility
3	Mekong Plain	4	Prey Veng K.Cham Takeo Kratie	Peam Ror Stung Trang Kirivong Chhlong	Peam Ror O Mlou Phnom Den Kahn Chor	Agriculture, irrigation, forestry + land use and fisheries and climate related issues, market and credit accessibility livelihood related issues
4	Plateau/ Mountains	3	Stung Treng Ratanakkiri Modulkiri	Sesan O'Chum Senmonorom	Sre Kor O'Chum Spean Mean Chey[4]	Agriculture, forestry+ land use and climate related issues (rainfall, drought, flood, storm), market accessibility infrastructure

It was expected that the FGDs in the four agro-ecological zones would raise different issues, including land use and climate change, as outlined below:

- *Coastal Area:* coastal/marine fisheries, agricultural crops, salt water intrusion, rainfall pattern, and natural shocks (storm, drought, irregular tides)
- *Tonle Sap Floodplain:* freshwater fisheries, agricultural crops, forestry and land use, up- and down-stream agricultural activities and accessibility of irrigation water, natural events (drought, rainfall, flood, storms)
- *Mekong Floodplain:* rice cultivation in the lower Mekong and agro-industrial crops (rubber, cassava plantation) in the upper Mekong, climate change related issues and natural shocks, land use change
- *Plateau/Mountain*: agro-industrial crops (rubber, cassava), forestry and land use.

4 Based on pre-FGD observations and consultation with the head of the Provincial Department of Environment (PDoE), the team decided to shift from the selected site to Bu Chri village in Picheada commune where majority of agricultural activities take place.

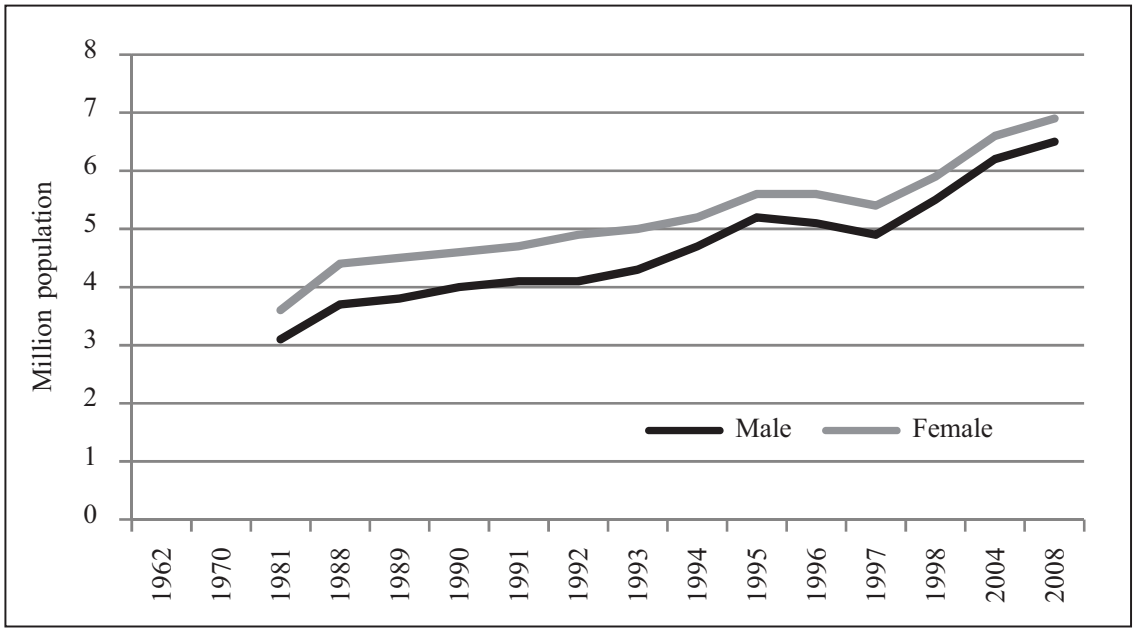
3

Overview of Cambodia's Rural Population and Agricultural Sector

3.1. Cambodia's Rural Population

Of the 2.8 million households recorded in the 2008 Census, 81.7 percent live in rural areas. The 2008 Census puts Cambodia's total population at 13.4 million (51.5 percent female, 48.5 percent male) with estimated growth rate of 1.54 percent per annum and average population density of 75 persons per km^2 (NIS 2009). The lowest population density is in the Plateau/ Highland areas in the northeast, where about 30 percent of the populace are living below the poverty line[5]. The average household size is four to five persons with the exception of the Plateau/Mountain Area where average household size is five to six persons (NIS 2008).

Figure 2: Population, 1962-2008



Source: NIS 2008

With the majority of Cambodians living in rural areas, livelihoods are heavily dependent on agriculture. Most earn approximately USD30 per month, which does not ensure household food security, and many face hunger. In terms of geographic distribution, approximately 52 percent of the population live in the Plains Region, 30 percent in the Tonle Sap Plains and about 7 percent in the Coastal Area. The remaining 11 percent live in the Plateau/Mountain Region which covers 38 percent of the total land area. Prior to 2000, access to this area was difficult. However, major infrastructure development since 2003 has improved national roads and village roads are better connected to major areas (see Tables A1 on population density, A2 on education, A3 on labour force and A4 on employment).

5 Representative of Plan International in an interview with Radio Free Asia, www.rfa.org (accessed 24 February 2011)

3.2. The Agricultural Sector

Agriculture has been the first priority of the government's development strategies since 1993. Besides rice farming, most rural people grow cash crops such as cassava, cashew, maize and beans, and raise poultry (chickens, ducks) and livestock to supplement daily subsistence and income earning. Mechanisation in the form of modern farming equipment is being introduced into the agricultural sector. Albeit gradual, animal draught power is being replaced by two-wheel (hand) tractors, tractors, harvesters and threshers. However, traditional agricultural techniques and seeds are still widely used, farming is predominantly rainfall dependent, and most farmers grow only one crop a year. Rice is grown in four major ecosystems: rain-fed lowland rice, rain-fed upland rice, floating rice and recession rice[6], and dry season irrigated rice.

Forests and fisheries make equally important contributions to agricultural development and economic growth. Forest resources are valuable to forest dwellers and communities close to forested areas. Sub-forest areas and forests provide many products, especially timber, construction materials, bamboo, rattan, wild vegetables, traditional medicine and other non-timber forest products (NTFPs) for local subsistence. Before 1960, forests covered 73 percent (13.23 million ha) of the country's total land area, of which mangroves in the coastal areas occupied about 83,700 ha (MoE & Danida 2007: 27). The current extent of forest cover is estimated at about 59.09 percent (TWGFE 2007 cited in Chheng 2010: 2). The fisheries sub-sector is considered the second most important after rice. Fish consumption contributes around 70-75 percent of the protein in the national diet. Nevertheless, these resources have been increasingly degraded in terms of ecosystem services. Both fisheries and forests are under threat. Important wetland habitats, including coastal mudflat and mangrove, sea grass meadow and coral reef have been degraded.

The expansion of agricultural activities, such as rice farming and agro-industrial crops e.g. rubber and cassava, is seen as important to improving production. Such development, which is critical for food security and poverty alleviation, is likely to result in increased water use and demand. This is of growing significance, particularly since the rainfall pattern has become increasingly irregular, leading most farmers to choose new seed varieties for cultivation, particularly new strains of (90 day) rice. Water shortage is a major constraint to improving productivity. Efforts to develop irrigation infrastructure have partly eased the situation in some areas, but only about 30 percent of irrigation structures had been rehabilitated at the time of study. In addition, most irrigation schemes have been designed to provide supplementary irrigation water for wet season rice farming. However, certain medium- and large-scale irrigation schemes can supply sufficient water for dry season rice farming.

3.3. Agriculture's Contribution to GDP

Cambodia's economy has grown substantially since its integration into the free market economy. Average annual GDP growth was 9.5 percent for the period 1999 to 2008, peaking at 13.3 percent in 2005 (Theng & Koy 2010). However, this growth was narrowly based and largely dependent on four key sectors: garments, tourism, construction and agriculture. Different sources give slightly different figures in relation to the agricultural sector's contribution to GDP; Chao (2009) reports that the sector contributed 34.5 percent, while Wokker *et al.* (2011a) state that its share was 33 percent.

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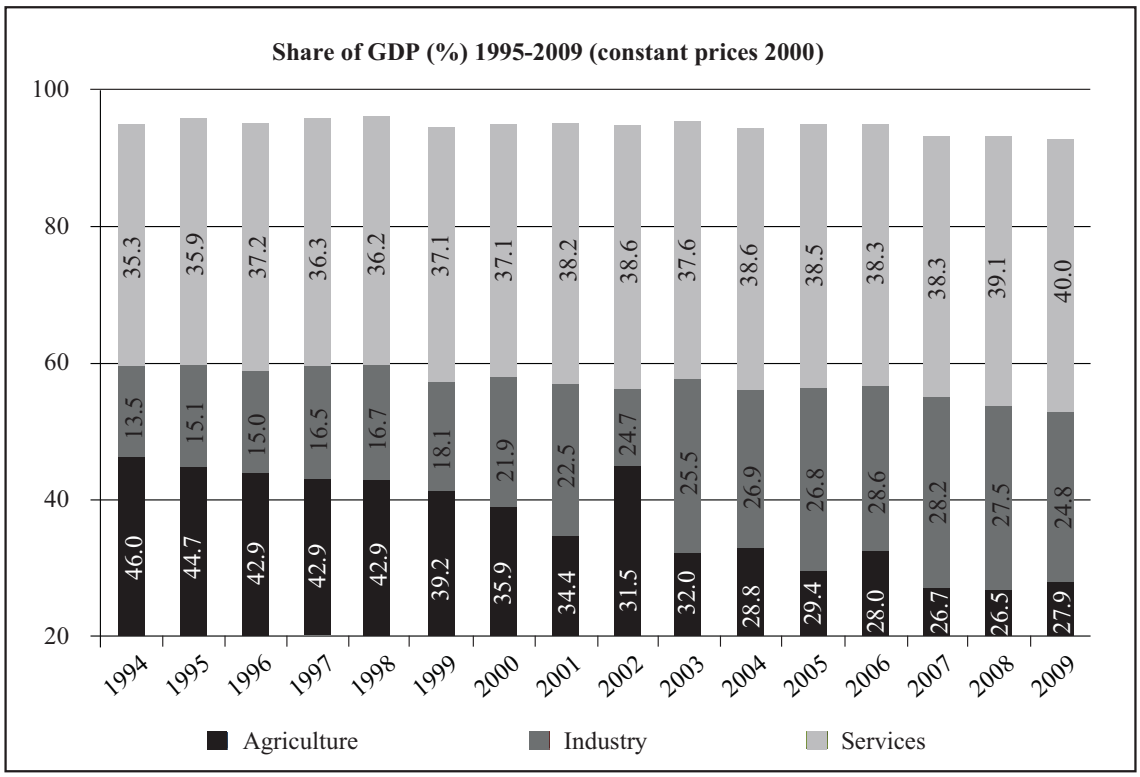
6 USDA website: http://www.pecad.fas.usda.gov/highlights/2010/01/cambodia/ Cambodia: Future Growth Rate of Rice Production Uncertain (accessed 26 January 2010).

According to IMF (2009) data, as of 2009 agriculture's share of GDP had gradually declined to almost 28 percent from 46 percent in 1994 (Figure 3). Rice production is central to this sector: not only do the majority of Cambodian farmers depend directly and indirectly on the success of the rice crop each year, but being the staple food, rice production is a critical factor in the national effort to promote food security. Other major crops (maize, cassava, soybeans and other cash crops) have recently emerged as marketable crops that can improve livelihoods and generate revenue and savings.

Crop production contributes the highest share to the agricultural sector followed by fisheries, livestock and forestry, in that order (Figure 4). Rice has contributed significantly over the last decades. Its share of GDP increased from 6.7 percent in 2002 to 8.6 percent (29 percent of agriculture sector's total GDP share) in 2007, at 2000 prices (NIS 2009 cited in IMF 2009: 3).

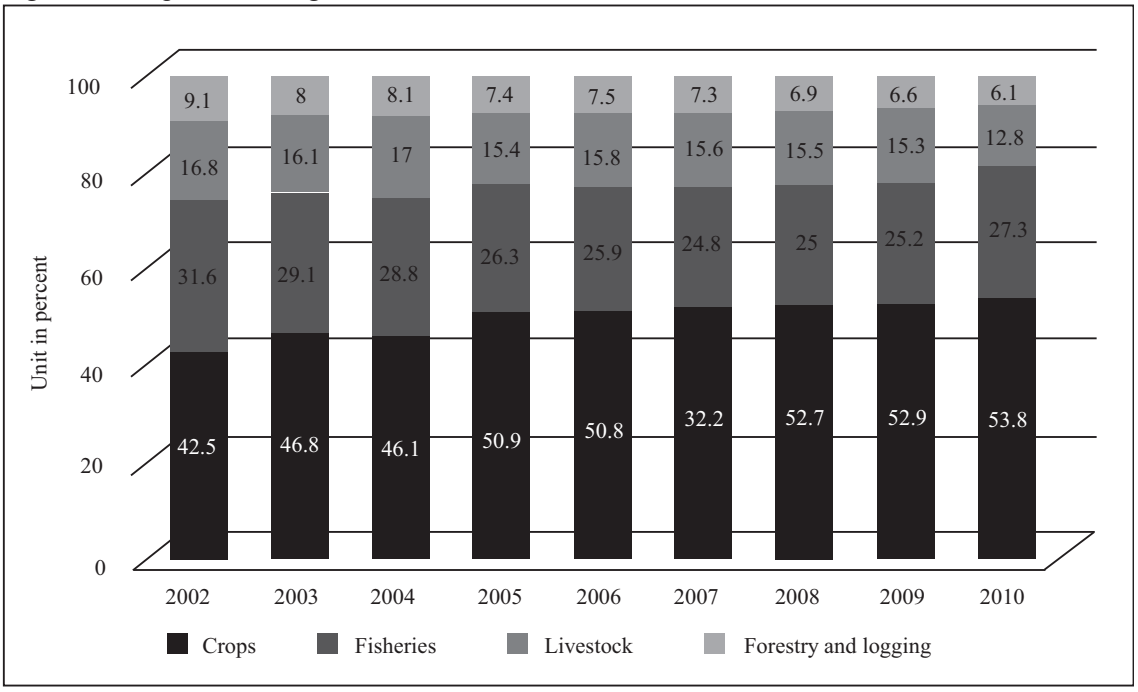
Figure 3: Percentage Share of GDP (constant prices 2000),1994-2009



Source: IMF 2009

In terms of the fisheries and forest sub-sectors' GDP contribution, any further increase seems unlikely unless legal frameworks and law enforcement are strengthened. These resources will come under increasing threat due to population growth or they will be diminished due to agricultural expansion. Increased loss of fishery and forest resources might pose significant constraints on the rural poor in particular. Strengthening law enforcement can ensure sustainability of these resources.

Figure 4: Composition of Agricultural Sub-sectors, 2002-2010



Source: MAFF 2007, 2010a, 2011a

3.4. Policies, Legal Framework and Institutional Arrangements

Cambodia has prioritised agriculture as the main sector to alleviate poverty in the country. The government's national development strategies for the period 1993-2011 have been set out in the Socio-economic Development Plan (SEDP I) 1995-2000 and SEDP II 2001-2005; the National Poverty Reduction Strategy (NPRS) 2003-2005; Rectangular Strategy (RS) Phase I (2004) and II (2008); the National Strategic Development Plan (NSDP) 2006-2010; and the NSDP-Update 2010-2013. The NSDP is a comprehensive strategy to synthesise various policy documents (RGC 2006), with agriculture as the government's first priority in improving productivity and diversification, land reform, mine clearance, fisheries and forestry reforms (RGC 2008), and as the main vehicle for achieving the government's strategic goals (RGC 2010a). In 2010, with a view to increasing rice export, the government released a policy on the promotion of rice production and milled rice export with the goal of exporting one million tonnes of milled rice by 2015. The vision is to bring Cambodia into the world market as a key milled rice exporting country. With the government's commitment to removing all barriers to milled rice export, measures related to rice production, collection and processing, logistics and marketing have been set. The policy clearly assigns specific responsibilities to all government agencies concerned (RGC 2010a).

There are two other sector level strategies, which specifically aim at improving agriculture and water management – the Agricultural Sector Strategic Development Plan (ASSDP) 2006-2010 and the Strategy for Agriculture and Water (SAW) 2006-2010. SAW has recently been updated and extended to cover 2010-2013. The ASSDP 2006-2010 is a specialised policy on agriculture, fisheries and forestry that captures relevant elements from the RS and NSDP. The overall objective of this strategy is to improve agricultural productivity and diversification, mostly in the rice sub-sector. It has five programmes: enhancement of agricultural productivity

and diversification; increased market access for agricultural products; strengthening institutional, legislative framework and human resource development; sustainable fisheries resources management; and sustainable forestry resource management (MAFF 2005).

The SAW 2006-2010 is similar to the ASSDP in that it aims to enhance agricultural sector growth through rehabilitation and construction of physical infrastructure. SAW was updated and extended to cover 2010-2013. According to ADB (2008), farmers' access to irrigation water is still limited given that only around 19 percent (274,172 ha) of the total cultivated land area is irrigated. However, the irrigated area has since increased to 1,064,263 ha (MOWRAM 2009) as a result of the rehabilitation and construction of small, medium and large scale schemes, bringing the total number of irrigation schemes to 2,403. The Ministry of Water Resources and Meteorology (MOWRAM) set its vision in the RS to increase the irrigated area from 25 percent to 50 percent by 2010. This is consistent with the current increase in agricultural productivity, especially increased rice production from 6.26 million tonnes in 2006 to 8.25 million tonnes in 2010 (MAFF 2011a: 18).

Five programmes are identified in the strategy, namely: 1) Institutional Capacity Building and Management Support for Agriculture and Water; 2) Food Security; 3) Agriculture and Agri-business (value chain) Support; 4) Water Resources, Irrigation Management and Land; and 5) Agricultural and Water Resource Research, Education and Extension. MAFF and MOWRAM are responsible for leading SAW, which is implemented by the Technical Working Group on Agriculture and Water (TWGAW).

4

Current Agricultural Practices and Technologies

4.1. Major Themes in Agro-ecological Zones

Table 2 presents a summary of key activities at the study sites, as reported during the FGDs and observed by the research team.

Table 2: Key Activities in Study Sites, by Agro-ecological Zone

No.	Agro-ecological zone	Major activities in the study sites
1	Coastal Area	• Fishing is the major activity; but individual catches have declined. • Catch per unit results in little income; fishing alone can no longer cover the cost of basic daily household needs. • None of the fishers do offshore fishing. • Diversification of crop cultivation has increased.
2	Tonle Sap Plain	• Activities vary depending on geographical landscape. • Rice farming is the major source of income/livelihood in Kompong Chhnang, Pursat and Battambang provinces; farmers in Battambang and Pursat can grow at least two crops a year. • Cash crops (green beans, corn) are grown in Kompong Chhnang, but cultivation is family-scale on small plots. • Freshwater fishing integrated with rice or cash crops (green beans, corn) is a major source of income/livelihood in floating villages in Siem Reap province; crops are usually grown during recession/dry season. • NFTP collection including firewood is the major source of income/daily subsistence in Kompong Thom province, but forest areas have been converted to rubber plantation. • Most villagers face hardship in meeting their daily needs and have turned to growing cash crops. • Most farmers have experienced severe drought at least once. • Lack of water is a significant constraint.
3	Mekong Plain	• Rubber is major source of income/livelihood in Kompong Cham province. • Cassava and other cash crops (green beans, peanuts, water-melon) are main crops in Kompong Cham and Kratie provinces. • Rice farming is major livelihood/income source in Prey Veng and Takeo provinces; farmers in Prey Veng grow two rice crops a year, but not on the same plot of land owing to topography i.e. slope, whereas farmers in Takeo grow two rice crops per year on the same plot of land. • Changing rainfall pattern is a worry for most FGD participants.
4	Plateau/Mountains	• Rubber is major source of income for some households in Mondulkiri province. • Cassava and other cash crops e.g. soybeans, mung beans and maize are the main crops in Mondulkiri, and Ratanakkiri provinces. • NTFP collection is major source of income/daily subsistence in Stung Treng province. • Rice farming is traditionally practised in the upland area. • Several patches of forest have been converted into rubber or cassava plantation • Several villagers are employed as daily wage workers.

Source: FGDs, May 2011

4.2. Crop Cultivation

Major crops grown in Cambodia are rice, maize, cassava, sweet potato, mung beans, green beans, peanuts, soybeans, sesame, sugarcane, rubber and tree fruits (MAFF 2010a; NIS 2008). Maize and cassava have been the second largest crops in recent years in terms of production and livelihood improvement.

Prior to 1993, rice yield varied from 1.3 tonnes to 1.5 tonnes or 2 tonnes per ha. Wet season rice takes almost six-months to reach maturity. Six-month rice farming is known locally as "heavy rice", and rice varieties that mature in three months are called "light rice". These terms are applied to rice farming in both seasons and both types are cultivated in different agro-ecological zones, i.e., rainfed upland, rainfed lowland, floating rice and irrigated dry season or recession rice.

Up until the early 1990s, soil quality was said to be richly fertile and chemical fertilisers, pesticides and herbicides had barely been used. This reflects the use of traditional practices in rice farming where majority of farmers depended on good soil quality as a main important input. Fertiliser and pesticide use has since been gradually increasing due to poor soil and low fertility.

Agricultural technologies have been imported to improve development efforts in the country, especially in the agricultural sector. Chemical fertilisers and pesticides, and agricultural machinery were imported mostly from neighbouring countries, particularly Vietnam and Thailand, to meet essential needs. Currently, most agricultural machinery is imported from China and the United States. Although these technologies are significant inputs, particularly in rice farming, most farmers who can afford these use them inappropriately. Poor farmers continue to use traditional practices since they are unable to access said technologies.

4.2.1. Rice

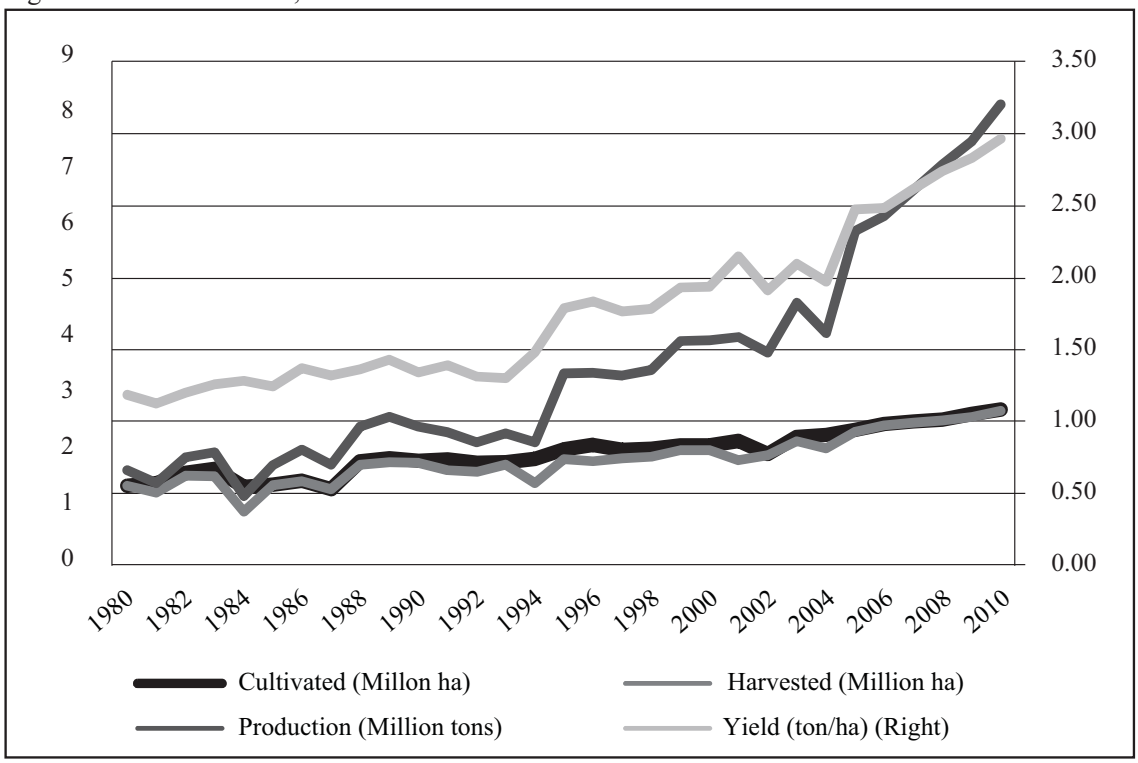
Rice is a traditional crop for Cambodians, with rice farming systems having existed in the country for more than two thousand years (Nesbitt 1997 cited in Yu & Diao 2010: 4). In addition, rice and other main crops have been main sources of income for the majority of Cambodia's rural population. Population growth implies greater consumption; as such, improvements in agricultural productivity will be needed to respond to such demand. In 2010, the total area of rice farming was 2,795,892 ha (MAFF 2011a).

Most diversification in rice cultivation so far concerns seed variety. Traditional and new varieties are grown for domestic consumption and market demand. Farming is still largely based on extending the cultivated area to increase yield, but productivity remains low even though traditional seeds are being gradually replaced with modern varieties. Nonetheless, rice productivity increased from 1.5 tonnes per ha in 1994 to 2.8 tonnes per ha in 2009 (Figure 5), with dry season rice yields averaging around 4 to 6 tonnes per ha. However, dry season rice farming contributes about 14 percent of total production (Figure 7). FGD participants confirmed that the Vietnamese rice seed, coded '504', is highly productive and marketable. Most farmers in the Mekong or Tonle Sap Floodplains prefer this seed and grow two or three crops a year. Rice 504 is a kind of "light rice" that can produce a yield at three-month intervals.

Despite the annual increase in rice cultivation since 1980, including cultivated land and harvested areas as well as production (MAFF 2010a, 2011a), the series of floods in 1984, 1996, 2000 and 2001 (Figure 19) and droughts over the last two decades, especially in 1983, 1991, 1994, 1997, 1998 and 2004 (Figure 21), destroyed hundreds of thousands of hectares of paddy fields. As a result, annual rice production slightly changed, particularly in 1994 and 2004.

The aggregate impacts from flood and drought likely posed a significant constraint to annual rice production. Unpredictable changes in climatic conditions, i.e. flood, drought and other natural shocks could have adversely affected productivity. Measures to mitigate such impacts are urgently needed to prevent food insecurity.

Figure 5: Rice Cultivation, 1980-2010

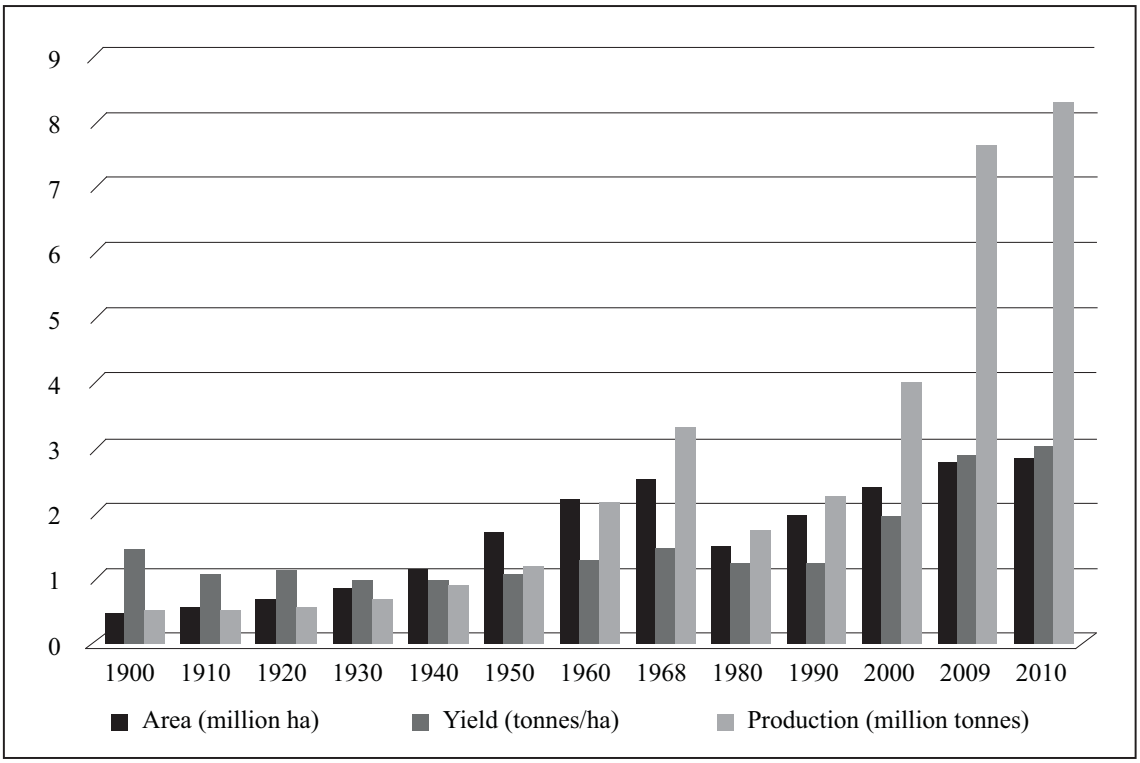


Source: MAFF 2010a, 2011a; NIS 2008

Although production has increased annually, rice surplus for export has only been significant since 2000 (Figure 6). Average surplus was about 1.6 million tonnes in 2009-10 (MAFF 2010a) and 3.93 million tonnes in 2010-11 (MAFF 2011a: 3). Wet season rice farming mostly depends on rainfall with some supplementary water from irrigation. In terms of yield, dry season rice farming is more productive, albeit dependent on the availability of irrigation water.

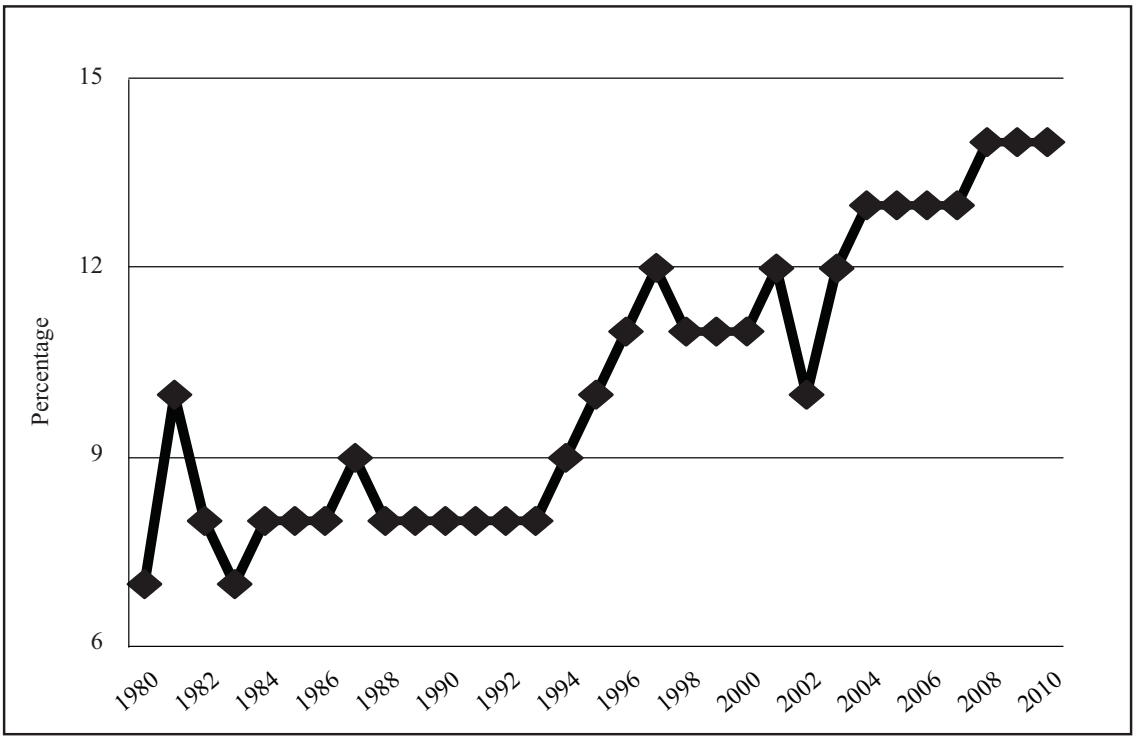
Lack of water during dry season rice farming is a significant constraint and has occasionally caused conflict among farmers (CDRI 2010a, 2010b, 2010c). Inadequate irrigation water allocation which coincides with drought has been a severe constraint to intensifying rice productivity. As mentioned earlier, the government of Cambodia has recently prioritised as a means of increasing agricultural productivity (Wokker *et al.* 2011b).

Figure 6: Rice Cultivation in Cambodia, 1900-2010



Source: MAFF 2011a, 2011b

Figure 7: Dry Season Rice Cultivated Area, 1980-2010



Source: MAFF 2010a, 2011a; NIS 2008

Rice Cultivation Methods

Cambodian farmers employ two popular (and traditional) rice cultivation techniques: broadcasting and planting rice. For both, primary preparation of land is an essential part of the process for wet season and dry season rice farming. It involves spreading manure, which acts as mulch during the pre-planting stage, and ploughing. These activities start in the early wet season, usually the first week of May, though sometimes the rains do not arrive until mid-May. Preparation for dry season farming generally begins in late October or early November or even early December after the wet season rice crop has been harvested, though the timing can also depend on topographical features, for instance, farmers in flooded areas can commence dry season rice farming as the water starts to ebb such as occasionally practiced around the Tonle Sap and Mekong Floodplain.

Broadcasting Rice: Known locally as *"srov pung rus"*, this is done a month before the onset of the wet season in early April. Fertiliser (manure) is spread over the field and ploughed in, after which the soil is left to dry (locally called "soil cooking") for almost a month in order to make it friable. The field is then ploughed again and seed is broadcasted.

The amount of seed sown varies from 100 kg to 160 kg or 200 kg per ha as some farmers apply more seeds to compensate for anticipated damage and/or poor germination rate and then thin seedlings as necessary, while others are confident in seed quality and are careful not to use more than necessary. Such farming is becoming more popular because it is less labour intensive; it takes just one day for two people to broadcast seed on 1 ha of land. However, the yield from this kind of cultivation tends to be low compared to the planting technique.

Srov pung rus may take from a few days to a week to complete, depending on input application (labour and seed) and/or machinery availability during the broadcasting stage. For example, ploughing can be done in just a half day using a tractor and within one day using a hand tractor, while using animal draught power takes three full days (or six mornings). Generally, broadcasting cultivation can be divided into two stages: pre-planting preparation which takes a few days and sowing seed which can be done within a day. Further details of the steps involved in this type of cultivation, collected during FGDs with local farmers, are summarised below:

1. Spreading manure on the field takes from 2-3 hours to one day depending on available machinery; manure can be transported and spread within a day using a tractor or hand tractor, but the same task takes one and a half to two days using animal draught power. At least 4 to 5 ox-carts of manure are applied per ha (one cart load is equivalent to about 35-60 kg dry manure or 70-120 kg fresh manure). The total amount of manure applied per ha varies from 200 kg, 350 kg to 500 kg. Both fresh and dry manure is used and most of it is home produced, though some farmers buy manure from neighbours as well.

2. Ploughing can be done within half a day by tractor, one day by hand tractor or two-wheel tractor, or three days using animal draught power.

3. After ploughing the land is left fallow for about one month (during April to May before the first rain) to allow the manure mulch to decompose and loosen the soil.

4. Re-ploughing and preparation for sowing, i.e. field is harrowed.

5. Broadcasting seed takes two people a day per hectare.

Planting Rice: The other rice cultivation technique is known locally as "*srov son tung* or "planting rice". There are two types of *srov son tung*: heavy rice which takes almost six months or nearly 180 days to harvest, and light rice which takes just three months. There are four stages to this farming technique.

1. Ploughing and soil preparation usually takes a week and is done before the approach of the wet season to loosen soil so that nutrients from subsequent application of manure can permeate more deeply. Manure is generally spread on the fields before ploughing. Farmers have to prepare two separate plots of land: the nursery bed to sow seeds and nurture seedlings, and the rice field.

2. Preparation of the nursery seed bed and broadcasting seed takes half to one day. Amount of seed sown varies from 150 kg to 200 kg per nursery plot, which provides enough seedlings to plant 1 ha. Seed begins to germinate within a week of being sown. "Light" rice seedlings are grown on for 25 to 35 days before being transplanted; "heavy "rice seedlings are ready for transplanting after 40 to 45 days.

3. When the seedlings are mature enough for planting out, the field is ploughed for a second time. Once uprooted, the seedlings must be planted within a day.

4. Transplanting seedlings is labour intensive: it can take at least 15 people one day to plant 1 ha of rice field.

Although cultivation costs are higher than broadcasting seed, yields are much higher. With good husbandry, transplanted rice can yield 4 to 5 tonnes per ha while the broadcasting method gets maximum 3 tonnes per ha. However, poor husbandry associated with improper application of inputs and negligence may result in low productivity for both cultivation methods.

4.2.2. Other Major Cash Crops

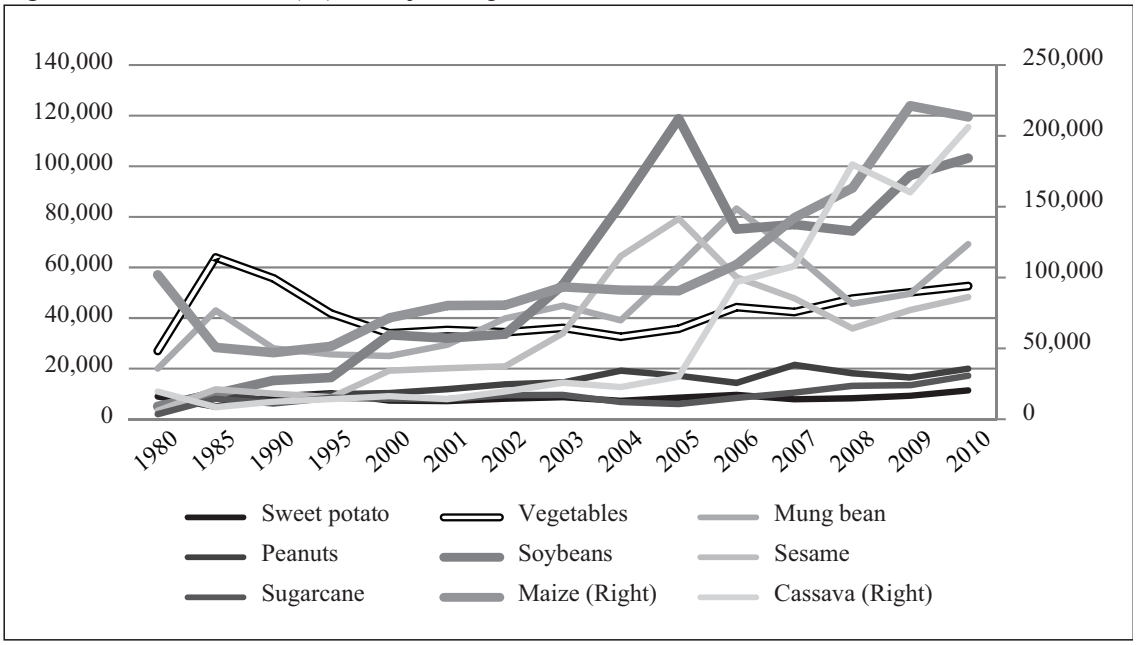
The production of cash crops (maize, soybeans, mung bean, sweet potato, water melon) has overall slightly increased and depended on market demand. Cash crops are considered a main source of income for improving livelihood and savings. These crops are often grown in the highlands where the soil is rich and fertile. Cultivated areas of maize, soybeans and cassava have significantly increased during the last decade but those of cassava and soybeans declined in the last few years because of low market demand (Figure 8). Since 2003/04, the market has been stable and some agricultural products have been exported, for instance, rubber, cassava and maize (MAFF 2010a). Expansion of the cultivated area has resulted in increased production (Figure 9). Use has markedly changed in that areas previously characterised by shifting cultivation[7] are now under permanent cultivation.

Cassava production increased steadily from 1998 and then more rapidly from 2005. Majority of farmers in upland areas shifted to growing this crop because of market demand. Cassava yields vary from 50 to 100 tonnes per ha. It is grown in the early wet season, particularly in mid-May, though late rains can delay cultivation. FGD participants explained that cassava tubers take almost six or seven months to form, and are generally harvested after eight or nine months. If farmers can delay harvest until the tenth or twelfth month, the tubers are bigger and fetch higher market prices which can be upped to USD2000 per ha. The cassava price can

7 Shifting or slash and burn cultivation, traditionally practiced by most indigenous people, used to be commonplace in the Highland Areas. Land use changes in recent years are primarily due to the influx of migrants especially from the Mekong and Tonle Sap Plains (FGD 2011).

range from USD900, USD1200 to USD2000 per ha depending on location. FGD participants reported that farmers were growing more cassava in anticipation of its price recovering (FGDs 2011).

Figure 8: Cultivated Area (ha) of Major Crops, 1980-2010

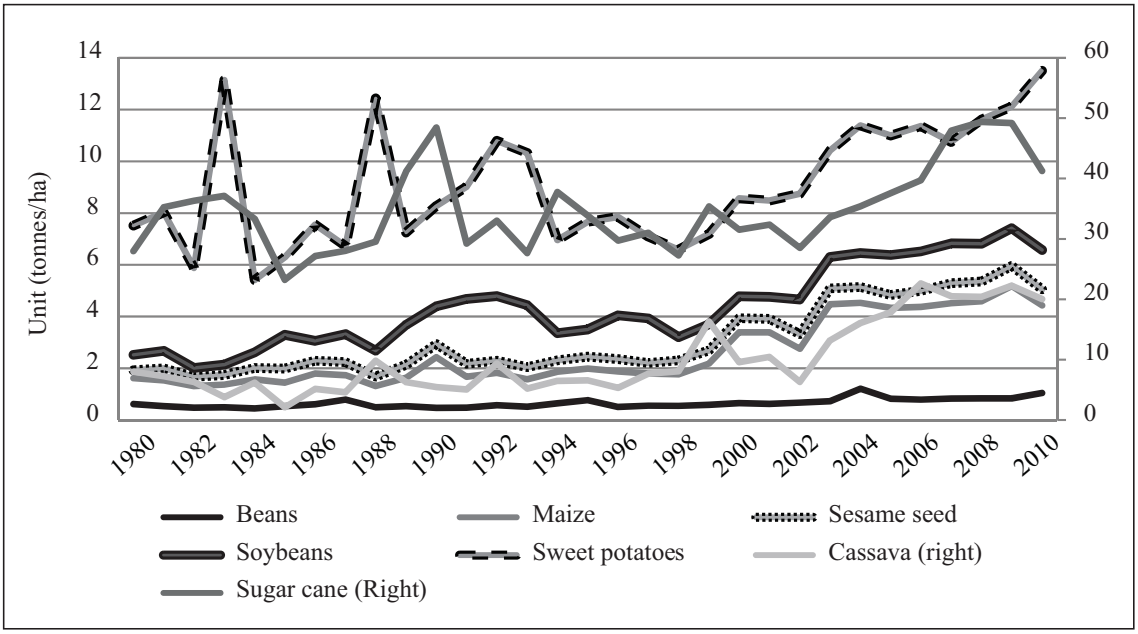


Source: MAFF 2010a, 2011a; NIS 2008

Findings from the FGDs and the researchers' observations suggest that most farmers, especially in the Mekong Floodplain and Plateau Area are growing more cassava. At the time of study, farmers were expecting its market price to rise. The fluctuating price of cassava in the last few years has impacted on farmers. The price can vary from 50 riels per kg to 100 or 200 riels per kg for fresh tubers; dry cassava, reportedly about one quarter of the weight of fresh cassava, can fetch between 500 riels to 800 riels per kg.

All crops need to be linked to market demand as this can be a potentially critical driver of production. The production of a single crop can vary significantly depending on market demand, with prices of individual crops occasionally being volatile. This also means that when production of a particular crop increases, that of other crops may decrease. For example, the current expansion of cassava (i.e. farmers' shift to mono-cropping cassava) has limited the production of other crops. Because production and therefore supply of these crops is limited, prices can be slightly higher than usual. Furthermore, crop prices are also often manipulated by middlemen during the period of cultivation, though the actual price realised by farmers at harvest time is lower. Efforts to promote crop diversification should consider and prioritise food security above commercial bio-energy crops which can lead to mono-cropping.

Figure 9: Major Crop Yields (tonnes per ha), 1980-2010



Source: FAOSTAT & MAFF 2011a

4.2.3. Rubber Plantation

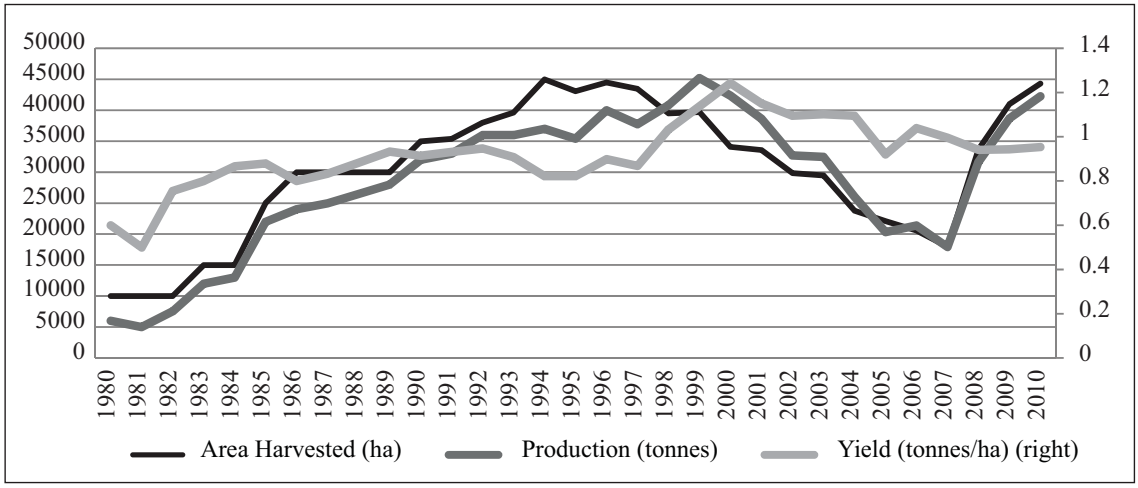
Most rubber plantations are in the Mekong Floodplain and Plateau areas in the northeast, renowned for their fertile red soils. Rubber is grown mostly in Kompong Cham, Kratie, Kompong Thom, Ratanakiri and Mondulkiri provinces (NIS 2008; Hing & Thun 2009). Majority of rubber estates are managed by private companies or are family-scale enterprises. Rubber trees are ready to be tapped for latex just four years after planting. Most rubber farmers intercrop saplings with cash crops (beans, cassava, maize) until the trees have matured for tapping.

The rubber cultivated area has expanded rapidly (Figure 10). MAFF records show that the area of new rubber plantations (including family-scale ones) stood at 143,028 ha in 2010, bringing the total cultivated area to 181,433 ha (MAFF 2011a). Field findings revealed that rubber plantations are being expanded to other locations, e.g. Stung Treng province.

The harvested area and production of rubber declined between 2000 and 2007 when thousands of old unproductive rubber trees were felled and the areas replanted. However, production is expected to increase significantly over the next few years. According to a source from the Department of Rubber Development, Cambodia's rubber export in 2010 went up to 42,000 tonnes from 31,184 tonnes in 2006 (MAFF 2011a) and is anticipated to double or even triple in the next few years when the new plantation areas are ready for tapping. This is expected to create more employment.

FGD participants said that farmers can earn approximately USD25 per day per ha collecting rubber latex, confirming researchers' observations that family-scale rubber plantation contributes significantly to household livelihood, income and savings. However, the availability and cost of labour are critical constraints in this sub-sector.

Figure 10: Profile of Rubber Cultivation, 1980-2010



Source: MAFF 2011a; FAOSTAT

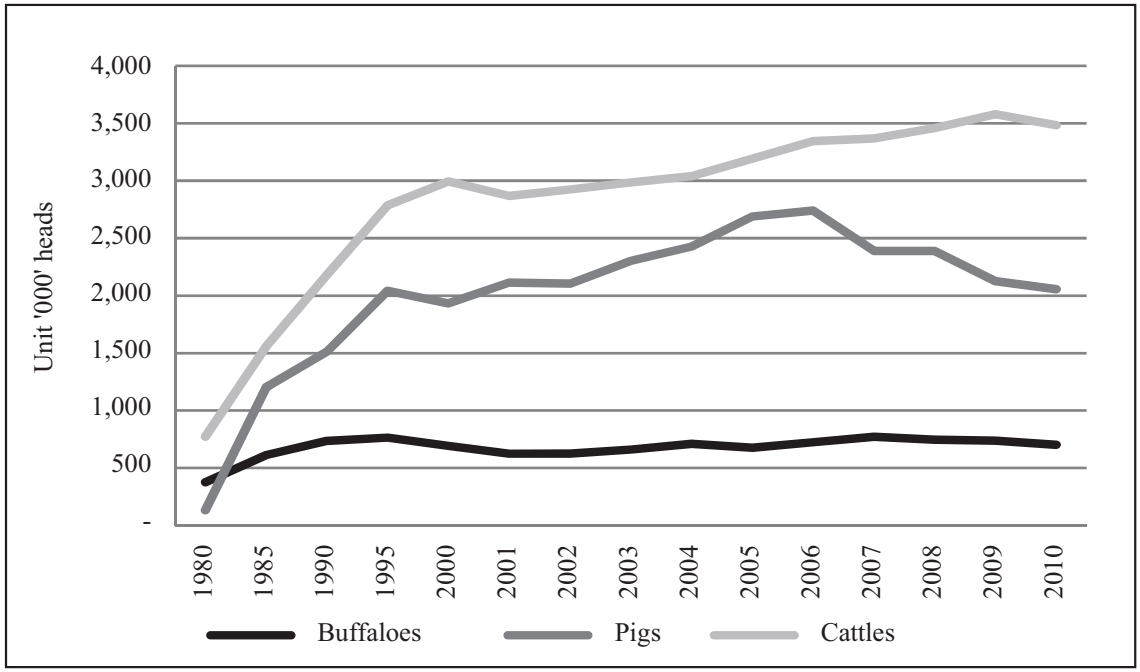
4.3. Livestock

Most households benefit from livestock farming as a source of livelihood or savings. An ADB (2008) report identifies major issues related to the livestock sub-sector which include lack of disease/infection control, high rates of mortality and morbidity, poor nutrition, small animal size due to poor breeding, weak veterinary services and lack of animal vaccines and medicines. FGD participants noted that disease and infections occasionally occur during the hottest months between March and early May. However, no animal deaths were reported during the field discussions. Livestock production has the potential to raise farmers' income more than other on-farm activities, but shortage of animal feed is a binding constraint. Fodder supply is limited in the dry season when farmers feed animals rice straw which has low nutritional value.

FGD participants claimed that farmers sell cattle or buffalo to buy a two-wheel tractor (hand tractor)[8]. Cattle can fetch approximately UDD250 to USD350 per head. Livestock and poultry, particularly chickens and ducks, are an important source of income. NIS (2008) and MAFF (2010a, 2011a) records indicate that approximately 15 million birds of annual production were produced from 2000 to 2008. However, the outbreak of avian flu in 2004 led to decline in this number which subsequently recovered and had increased to approximately 29 million heads by 2009, before dropping to 21 million in 2010. As shown in Figure 11, livestock production has increased steadily over the last three decades.

8 Hand tractors cost USD1000 to USD2000 per set (including a plough). The multiple functions of a hand tractor, for example, ploughing, transport and pumping water, make it a popular choice among farmers.

Figure 11: Livestock (‘000 heads), 1980-2010



Source: MAFF 2010a, 2011a; NIS 2008

4.4. Fertiliser

Fertiliser use in Cambodia is lower than in its regional neighbours, even though it is widely acknowledged as a remedy for nutrient deficient soil (ADB 2008). However, there has been a significant increase in fertiliser consumption from a low base in the 1980s and early 1990s when only about 31,000 tonnes of fertiliser were imported annually.

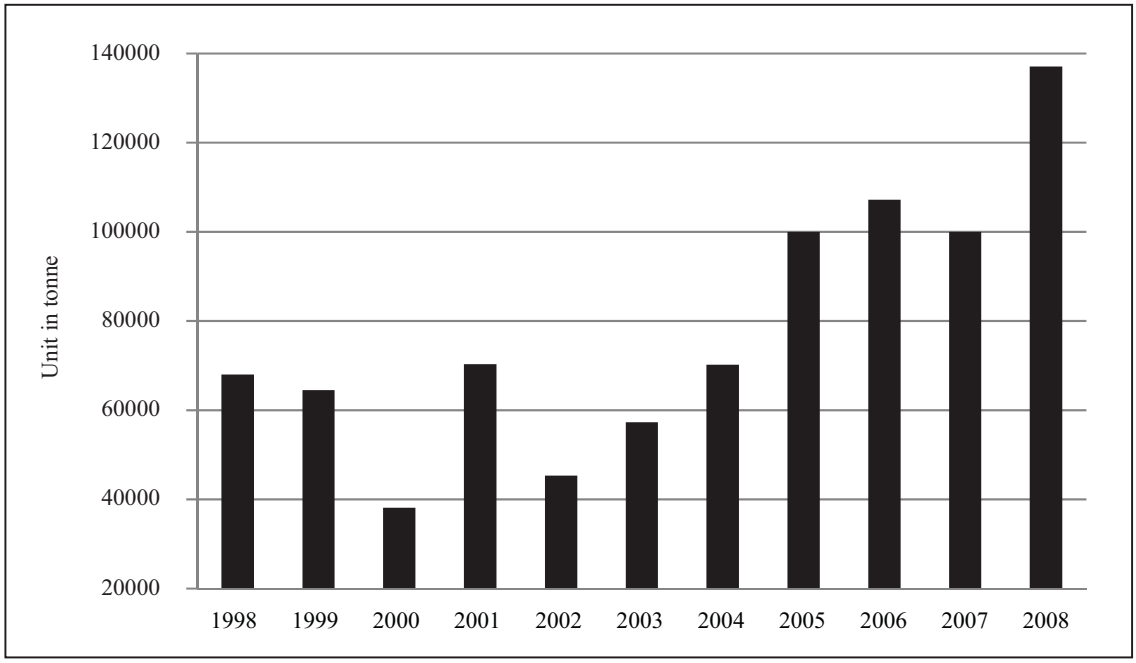
The private sector and the public sector Agricultural Inputs Supply Company (AIC) started importing fertiliser in 1991, raising consumption to 80,000 tonnes in 1995 and 245,854.12 tonnes in 2010.[9] An ADB study reports that in 2008, about 70 percent of fertiliser supply was imported from Vietnam and Thailand and estimates that Cambodia’s fertiliser demand stood at 130,000 tonnes (ADB 2008).

MAFF (2008) reports that market surveys on fertiliser demand and supply, including price fluctuations, were conducted in order to improve AIC’s business. AIC collaborates with 77 fertiliser merchants/companies, including five agricultural development communities, in various provinces. Twenty-six companies have been permitted to import agricultural inputs during that time. ADB (2008) notes that fertiliser is imported by private companies and smugglers (Table A5). MAFF (2011a) has also granted permission to 62 companies to import fertiliser and other agricultural inputs. In 2010, 245,854 tonnes and 100 gallons of fertiliser were imported, along with 2,509 tonnes, 50 bottles and 146,000 litres of pesticide.[10] The amount of imported fertiliser recorded by the Ministry of Commerce as cited by MoE (Figure 12) is lower than the figures reported by MAFF.

9 AIC signed two contracts with Green Mount Co Ltd in 2006. However, Green Mount Co. Ltd failed to fulfil its import obligations and the contracts were cancelled.

10 Liquid fertilisers, including organic ones, are kept in bottles.

Figure 12: Fertiliser Import (tonnes), 1998-2008



Source: MoE 2010

FGD participants reported that most farmers apply fertiliser but in varying amounts, from one 50 kg sack to three or four 50 kg sacks or seven 50 kg sacks per ha for wet season rice farming. Farmers in Phnom Den commune, Takeo province apply seven 50 kg sacks of fertiliser per hectare for the first cultivation and then apply even more for the second cultivation. In Svay Donkeo commune, Pursat province, farmers apply at least three to four 50 kg sacks of fertiliser per ha, whereas just one 50 kg sack of fertiliser is used per ha in Toul Khpush commune, Kompong Chhnang province. Poor farmers cannot afford to buy fertiliser. Fertiliser application is greater in the dry season and largely depends on the geographical features of the area and soil quality.

There is no technical training or knowledgeable advice on how to correctly apply fertiliser and pesticide. Farmers learn how to use these inputs through verbal explanation by the vendors rather than practical demonstration. According to ADB (2008), farmers use fertiliser at inappropriate times and/or in the wrong amounts. Paradoxically, fertiliser is overused during the dry season when the farm gate price of paddy is lower, raising the question of the economics of fertiliser use. The Cambodia Agricultural Research and Development Institute (CARDI) has disseminated recommendations about fertiliser application by agro-ecological region and soil type, but these are not followed due to lack of information and knowledge (ADB 2008).

4.5. Fisheries

Cambodia's inland and coastal waters are rich in fishery resources. In 2006 estimated captures of 360,000 tonnes, valued at around USD252 million, corresponded to about 8.4 percent of GDP [11] (MoE/Danida 2007: 37). Total catch in 2009 stood at 465,000 tonnes both inland and coastal fisheries (FiA 2009) (see Figure 14).

11 E. Baran *et al.* (2009: 3) report that capture fisheries and aquaculture contribute about 10 percent to GDP.

4.5.1. Coastal Fisheries

Marine fisheries make a significant contribution to national efforts for economic growth. Coastal fisheries are an important source of daily livelihoods, particularly for coastal inhabitants. Unlike other dense coastal populations in the region, the coastal population[12] in Cambodia is sparse and the majority are involved in fishing.

Annual catch has increased dramatically but catch per unit has declined due to population growth i.e. the growing number of fishers, which puts more pressure on natural resources and ecosystems, economic growth and development of fishing technology (MoE/Danida 2005: 187). Marine fish stock has not been assessed since the mid-1980s when Russian scientists estimated the total stock in Cambodian waters to be 50,000 tonnes (Figure 13). However, it is not completely clear which groups of fish were included in this estimate and it might have only included fish stock at depths greater than 20 m (MoE/Danida 2007: 44). For sustainable fisheries management, it is essential to evaluate the fish stock against annual catch figures.

Present captures, however, are greater than the fish stock's ability to naturally replenish and this might signal resource depletion. Catches could be used to assess fish stock and calculate the exact quantity of fish available for annual capture. Cambodia's territorial waters front the Gulf of Thailand, covering an area of about 320,000 km^2. The mean depth is 45 m, and the maximum depth is 80 m (MoE/Danida 2006).

Participants in several FGDs said that government officials and groups of fishers claim that catches are dwindling, but it is not clear whether it is merely catch per fisher that is declining while overall catch remains the same, or whether fish stocks are indeed decreasing. Fishing equipment such as motorised pushnets and dynamite are used extensively and trawl nets are used in water shallower than 20 m. Using such equipment to fish shallow waters is considered illegal, primarily because it damages coastal habitats such as coral reef and sea-grass meadow. Unsustainable use of mangrove resources associated with conversion of mangrove for saltpans or settlement may damage fishing grounds and destroy vital habitats.

Coastal fisher-folk revealed during the FGDs that the majority of fishing activities occur inshore and are mainly for daily subsistence and small savings. Fishing boats with engine size 5hp, 13hp and 50hp and even up to 150hp are operated both near and offshore[13]. Prior to 1990, Cambodian waters were believed to have been exploited much less intensively than other parts of the Gulf of Thailand, which have been dramatically over-fished following the mechanisation of the Thai fishing fleet in the 1960s. It must also be emphasised that foreign fishing vessels operate freely in these areas, including the undisputed area that is claimed only by Cambodia. Bann (1997: 41) also raises the issue that reliable records of fishing activities in the offshore area of the Exclusive Economic Zone (EEZ) are not available.

Marine fish catches by province indicate that the smallest are landed in Kep while the largest occur in Koh Kong (Figure 13). Under the current fisheries management reform, Kep has been merged with Kampot province in relation to annual fisheries capture. As the number of fishers has increased, the catch per family has declined compared to two decades ago.

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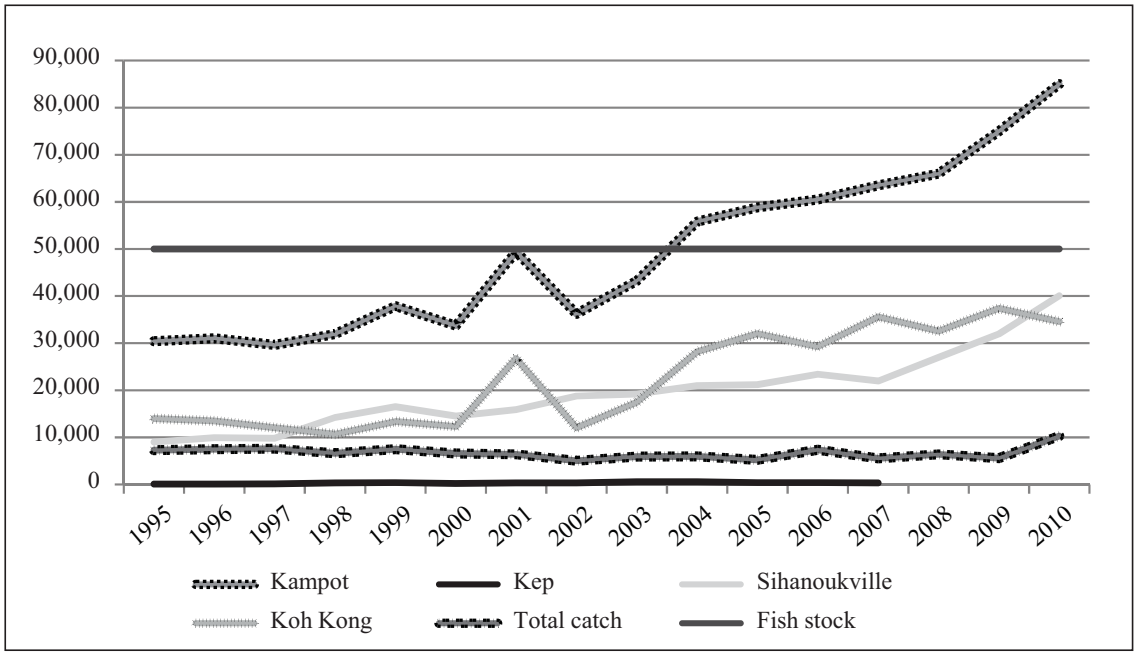
12 Estimated total population living along the 435 km of coastline in the four coastal provinces is approximately one million (NIS 2009: 23)

13 Better-off families have better equipment and bigger boats. Also, they can employ several workers and stay overnight or even a week while fishing offshore. Fishing activities include crabs (blue swimming crab, locally called horse crab), shrimp, mackerel and squid. Some fishers operate near the islands or in coral reef areas where fishing is restricted by law. Also, certain fishers use unsustainable methods e.g. dynamite and/or poison in coral reef areas.

Figure 13: Annual Marine Catch by Province (tonnes), 1995-2010



Source: FiA 2008, 2009a, 2010

Inshore fishing

Traditional practices are mostly used in shallow water, mangroves, estuaries, creeks or the inter-tidal zone where biodiversity is rich, including terrestrial wildlife. Some fisheries products are collected by hand from the mudflats, beaches and mangroves. Poor fishers in particular engage in this activity, catching a variety of species such as molluscs (mud-snails, clams, cockles), crabs and shrimps; such work is mainly done by women and children. Inshore fishing is an important source of food for supporting daily subsistence.

Motorised and non-motorised boats are used to fish inshore areas. Fishing boats sometimes travel up to few kilometres offshore and along the coastline where average water depth is less than 10 m. Common fishing equipment includes traps (for crab and squid), pushnets, longlines and liftnets. Bagnets are popularly used to fish in rivers, estuaries and creeks in the Koh Kong area, even though they are classed as illegal and their use is restricted in the fisheries community zone.

Offshore fishing

Mostly small and medium traditional wooden boats equipped with an engine of 13hp, 25hp, 50hp or 100hp are commonly used for offshore fishing. Fishing gear includes purse seines, long-lines and various traps. Activities involve a one day round trip in 20 m deep waters or off islands. Offshore commercial fishing is carried out by international fleets; there are no estimates of their catches or revenue as catches are landed in their home ports (MAFF & MOWRAM 2008: 31). Commercial fishing vessels, mostly foreign, have either registered legally or illegally. Statistics on commercial fishing are not available, but it is unofficially reported that about one third of foreign boats operate illegally in Cambodia's waters. Foreign vessels are occasionally seen at sea or anchored in the bay off the islands.

Unrestricted access to coastal fisheries means they can be fished all year round. This provides small-scale and poor fishers a source of income for daily basic needs and tiny savings. Fishing in the wet season can be risky but it is also offers lucrative earnings. Tables 3 and 4 show the catch using different types of fishing gear.

Table 3: Seasonal Calendar of Coastal/Marine Fisheries

Activities/months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Inshore and shallow water fishing activities												
All kinds of crab[(a)]	■	■	■	■	■	■	■	■	■	■	■	■
Krill[(b)]					■	■	■	■				
Coastal bag net	■	■	■	■	■	■	■	■	■	■	■	■
Mullet[(c)]	■	■	■	■	■	■	■	■	■	■	■	■
Offshore fishing activities												
Blue swimming crab	■				■	■	■	■	■		■	
Squid	■	■			■	■			■	■	■	■
Shrimp					■	■	■	■				
Mullet	■	■	■	■	■	■	■	■	■	■	■	■
Aquaculture												
Cockles	■	■	■	■	■					■	■	■
Green mussels	■	■	■	■	■					■	■	■
Grouper - cage culture	■	■	■	■	■	■				■	■	■
Sea-bass - cage culture	■	■	■	■	■	■				■	■	■
Seaweed	■	■	■	■	■	■			■	■	■	■
Crab fattening	■				■	■	■	■	■	■	■	■

Source: FGD with coastal fishers, May 2011.

(a) Crabs and molluscs can be caught daily in the inter-tidal zone. Mud-crabs and sesame crabs are commercially valuable. Molluscs e.g. mud-snails, clams and cockles can be collected in the mangrove forest in particular. Blood cockles have good market value while other clams are just for subsistence.

(b) Peak harvesting of krill is in wet season between May to August or sometimes late August/early September. Krill is processed to make shrimp paste. Known locally as *ki*, it is mixed with salt and other ingredients, crushed and left to dry in the open air for a few days before it is put into jars. It is sold at USD2 or USD3 per kg. *Ki* is more popular among coastal dwellers, especially in Koh Kong and Kampot provinces.

(c) Mullet fishing can be done all year round in inshore areas, but offshore fishing in the wet season is risky due to heavy seas and strong winds.

Table 4: Different Types of Fishing and Fishing Gear

Type of fishing	Activities
Crab fishing	Most fishers are men. Fishing in both inshore and offshore areas is year round but declines during the wet season. Majority of boats land catches at the jetties near the villages. Mostly women, young children and elderly household members prepare fish for sale or own consumption. Most crabs are sold to middlemen[14] in the village(s) or the nearby market or are processed into crabmeat. Women are mainly involved in processing crabmeat and preparing fishing equipment. Women traditionally manage household assets, especially cash, and all household purchases and expenses. Crab traps and nets are used. Most offshore fishers use nets to catch blue swimming crab. The net length can be 50 m, 70 m or 100 m. Fishers prefer to use many 50 m or 70 m nets rather than a few longer ones. Small boats/family-scale fishing have 50 to 100 traps, and medium boats carry 100 to 200 or up to 500 traps. Commercial fishing boats can load 1000 to 3000 traps (offshore fishing). Inshore fishing catches include all kinds of crabs especially mud-crabs *(Scylla serrata),* whereas offshore catches are mostly blue-swimming crab. Size of blue-swimming crab catch depends upon their migratory behaviour (Ros 2003: 61). Blue-swimming crabs caught at open sea are larger than those in inshore areas. Catches are gradually declining both in quantity and size of the crabs. For market price, crabs are classified into grades. Large mud-crabs are sold at approximately USD10 per kg (author's observations in Phnom Penh markets, 2011). However, fishers sell good quality crabs to middlemen in the village for USD3 or USD4.5 per kg. Large blue-swimming crabs fetch a lower price than mud crabs, from USD5 per kg to USD7.5 per kg for live crabs. Further, crabmeat can be sold for a higher price, about USD10 per kg.
Shrimp fishing	Peak fishing is in wet season. It can earn high income during peak days of the month. Maximum catches occur for a few days or a week each month. Each boat can catch approximately 10-17 kg or up to 20-35 kg per day. Catches a few decades ago were reportedly higher than today. Inshore catches are at least 3-4 kg and 10-15 kg per day at the most. Offshore fishing commonly entails the use of trawlers or motorised push nets, though such heavy gear is restricted in shallow waters or community zones[15]. Hand push nets or small horsepower motorised push nets are used in inshore areas. Krill can be caught near the shoreline during high tide, and is processed into shrimp paste which has good market value.
Mullet	Fishers are indiscriminate, catching all kinds of fish. Offshore fishing is done from boats with medium or large engines; the boats have to leave early morning as the return trip takes a few hours and fishing takes another few hours. Market prices are volatile, depending on the amount of daily catch or season.
Squid	Net-traps are commonly used. Sea-snail shells (shell-traps) are also used to catch squid, especially spider-squid. Bait is put into empty shells to attract squid which sometimes use the shells as shelter. Such gear is mostly used in Koh Kong province. Boats can load approximately 80-100 net-traps or more than 200 traps for offshore fishing, or 500 to 1000 shell-traps.
Collecting by hand	Molluscs or crabs are caught by hand, mainly in the inter-tidal zone, e.g. in mangroves during the ebb tide. Most poor fishers are involved in this activity. Several species of mollusc are important for subsistence, but have little to no market value. *Seasarmid* (mangrove) crab can be caught in the mangrove trees at night. The crab can be processed into salty-crab and is sold for about USD1 per kg.

14 Some rich people in the village are moneylenders or middlemen. They lend money to fisher-folk to buy fishing materials, for instance a new boat, fishing gear or to pay for boat repairs. In return, the fisher-folk are obliged to sell fish to them in repayment of the loan. However, those fish are sold at prices below the market price; prices are often negotiated before the loan is granted, and if the fisher-folk do not agree they have to borrow elsewhere.

15 Certain coastal areas are designated as Coastal Fisheries Communities. Community members are responsible for the sustainable use, management and protection of fishery resources.

Type of fishing	Activities
Coastal bagnet	Coastal bag nets, known locally as *phorng pharng*, are only used in Koh Kong where they are laid across rivers, estuaries and creeks. Size of catch depends on the size of the bag net as well as location and tide i.e. waters are richer in nutrients at certain movements of the tide. Bag nets are used to catch various varieties of fish, for instance, shrimp, mullet and trash fish[16]. However, such fishing targets shrimps. Bag nets are emptied once every few days or even once a week. The amount of each haul can be 35 kg, 50 kg or even 100 kg. Coastal Fisheries Communities consider bag nets as destructive because the small meshed nets trap a huge amount of all kinds of fish including molluscs and invertebrates. A bag net is like a straight fence; lengths vary from 30 to 56 m or even 64 m. Bag nets are tied to poles placed in straight line at varying intervals of 5 to 8 m; the tails of the bag nets are 25 m or 30 m or 40 m long and several metres of chain keep the net tails underwater. Coastal bag nets are used all year round, though peak fishing time is related to tide. Generally, there are two tides a day, with amplitude of approximately 1.5m. This amplitude influences the migration and distribution of fish and other aquatic species.
Aquaculture	Introduced in 1985, but popular since 1991, shrimp farming is practiced mainly in Koh Kong province close to the Cambodian-Thai border. Tiger shrimp (*Penaeus monodon)* is the main species farmed. Pond yields were reported to be up to 7-8 tonnes per ha for new farms. However, the shrimp farm industry in Koh Kong has experienced serious problems such as disease and pollution. At that time shrimp culture was the important aquaculture activity and farming other species, e.g. oysters and green mussels, was not significant in terms of production and role in the economy. Given the severe problems, shrimp farms have been gradually abandoned. Some disused ponds are being used for fattening crabs, though only on a family-scale. Other aquaculture includes green mussels, grouper and sea-bass. Grouper fingerlings are collected from the wild whereas sea-bass fingerlings are purchased from a hatchery run by Thai farmers. Fish farming is mainly concentrated in Koh Kong province and some locations in Sihanoukville provinces, but seaweed farming is found in two other coastal provinces, Kampot and Kep. Cockle farming (wild cockles) occurs in Koh Kong and Sihanoukville provinces.

Source: FGD conducted with fishers in two coastal provinces in May, 2011

Results from FGDs and Observations

FGDs with coastal communities indicated that small-scale fishing is widespread in shallow waters and inshore areas. Most small to medium boats are moored along the jetties located in front of the villages. It was noted that boats are also anchored along the waterways of the rivers/ creeks. Some better-off households have large boats, i.e., motorised pushnets or trawlers whereas poor fishers[17] rely on hand-pushnets or collect fishery products by hand. Large vessels can operate far from the villages and stay around the islands or at sea for few days or a week before landing. Generally, such vessels have at least three to five hired workers who get a 20 to 30 percent share of the total catch while the remainder belongs to the boat owner. The bigger boats have engines with various capacities, sometimes up to 100hp. FGD participants noted that most fishers are aware that illegal fishing is still going on in inshore areas, shallow waters and restricted areas.

16 Trash fish are typically small fish that are used as feed in aquaculture, e.g. for crab, sea bass and grouper. Trash fish fetch a low price, just 100 to 150 riels per kg (USD1 = 4000 riels). Most trash fish are caught in motorised push nets, trawl nets and coastal bag nets.

17 Key informants said that most fishermen have diversified their activities. Current income from fishing is not enough to meet daily subsistence, a far different situation from two decades ago when fisher-folk could meet their livelihood needs through fishing alone.

Fishers catch a variety of fish, crabs, molluscs, shrimps and other invertebrates. Size of catches is variable. Sometimes fishers can catch a lot and other times hardly anything. Sometimes it depends on the tide i.e. the phase of the moon: catches of shrimp, squid and mullet are bigger in the crescent of the dark moon. However, most fishers recognise that fisheries captures have declined since the 1990s. Before, fishers could meet their household subsistence through fishing alone. Most poor fishers face hardship during the wet season due to little opportunity[18] to buy equipment during the peak season for their fishing activities. Poor fishing equipment leads to small catches with little monetary value.

Besides fishing, aquaculture, e.g. cockles and crabs, is being practised. Cockle culture is found along the coastline of Botum Sakor district in Koh Kong province where mudflats front the mangroves. The combination of mudflats and mangroves is potentially important as a vital habitat for various mollusc species. Fish farming, e.g. cage culture of sea-bass and grouper, takes place in deep water and good environment. Aquaculture can be seen near the floating villages in Peam Krasob Wildlife Sanctuary close to Koh Kong town and in Stung Hao district, Sihanoukville.

Declining fisheries resources have led to the establishment of community-based coastal resource management through coastal fisheries communities (CFC). However, CFCs' roles and responsibilities at best are barely functioning. Villagers occasionally raise concern about illegal fishing gear or destructive methods. The decline of coastal resources is related to weak legal framework and poor cooperation/coordination among government agencies. Furthermore, low awareness and education including lack of technical skills and lack of livelihood alternatives for daily subsistence are a critical factor (Ros 2003: 59). Renewable natural resources can provide continuous benefits, but only if they are managed sustainably.

4.5.2. Inland Fisheries

The Mekong River and its tributaries and the Tonle Sap area are considered the "food basket" of the country. In addition, the major part of the country forms the watershed of this unique river system which sustains a huge reserve of renewable resources, e.g. water, forestry and fisheries, particularly freshwater fisheries in the Tonle Sap Floodplain (Table 5). The Tonle Sap Floodplain is acknowledged as being the richest wetland ecosystem in the world, and for its contribution to both the national economy and livelihoods (Noeu 2001). Roudy (2002) emphasises the importance of the Tonle Sap Floodplain as one of the world's most productive ecosystems that also contributes extensively to food security and economic growth.

The Mekong River and its tributaries, Tonle Sap River, Lower Mekong River and Tonle Basak River flow across the country from north to south where they converge to form the Mekong Delta on the South China Sea. This river system is not only important as a main source of livelihoods and national revenues, but also for agriculture, especially rice farming. The Mekong's fishery resources have sustained and nourished the region's populace for centuries, but will be unable to continue to do so for much longer unless this resource is managed sustainably.

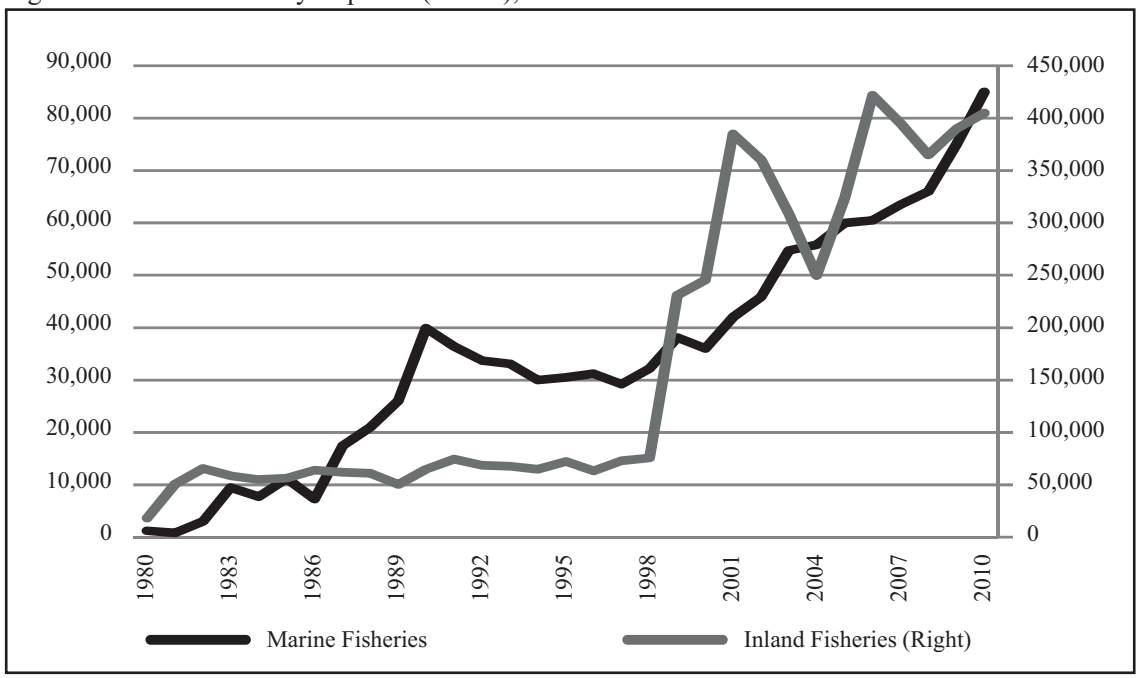
The Upper Mekong River and its upstream tributaries are restricted fishing grounds. Large-scale fishing or commercial fishing lots are not allowed. Several parts of the Tonle Sap Lake are also conserved as reserve habitats. The most lucrative fishing lots are located along

18 Most poor fisher-folk have no money to buy fishing equipment to net large catches of fish. So, they cannot earn much income during the peak season.

the Tonle Sap River and the Tonle Sap Lake where more than 200,000 tonnes of fish are caught annually (Yeam & McKenney 2003). Commercial and large-scale fishing is done from October to May as fishing is not allowed during the wet season.

Inland fisheries play a more important role than coastal and marine fisheries in terms of livelihood sustenance. Providing about 75 percent of dietary protein, freshwater fish is the second staple food after rice. Apart from local consumption, freshwater fisheries also contribute significantly to national food security (FiA 2009). (See Table A6).

Figure 14: Trend of Fishery Captures (tonnes), 1980-2010



Source: FiA 2009; 2010

Development of hydropower dams on the Upper Mekong River and its major tributaries will likely have significant impact not only on aquatic resources, water flow and ecosystems as well as associated detrimental effects on the environment, but also on agricultural croplands, local assets and communities who rely on natural resources for their daily basic needs. Among issues raised at the FGDs, it was pointed out that most areas along the Sre Pok and Sesan Rivers will be flooded when the hydroelectric dam is built. Settlements and croplands will have to be relocated. The dam will be built at the confluence of the Sesan and Sre Pok Rivers. Villagers said that the Sesan River has already been affected as a result of the Yali Fall Dam in Vietnam[19].

Changes in hydrological regime could potentially impact on deep pool habitats and aquatic creatures, especially deep pool fish. It is reported that deep pools have become so shallow during the dry season that all the fish are caught at once, totally depleting the pools. Irregular fluctuations in water level characterised by extreme highs and lows can cause flooding downstream.

19 The Yali Fall Dam was built in November 1993 and has a capacity of 720MW. It is located upstream on the Sesan River, about 70 km from the Cambodian-Vietnamese border. Every year since its construction, flooding has damaged local assets, including agricultural crops along the Sesan River in Ratanakiri province.

a. Upper Mekong River

Important habitats include deep pools, rapids, floodplain and associated wetlands. Although deep pools are widely acknowledged as being vital habitats, the definition of a deep pool is somewhat arbitrary; however, a deep pool is significantly deeper than the surrounding riverbed and retains water in the dry season when it may be isolated from the main river. Deep pools are ecologically significant in the conservation of a number of fish species (Chan *et al.* 2003). The Upper Mekong River is crucially important for deep-pool fish including freshwater dolphins and Mekong giant catfish. The huge forest area in the northeast constitutes the Mekong River's watershed. However, recent conversion of this forest area for agro-industrial crop plantations will inevitably result in land degradation.

b. Lower Mekong River

The Lower Mekong River meets the Tonle Sap, the Tonle Basac and Upper Mekong rivers in front of the Royal Palace in Phnom Penh city. The four rivers are locally known as *Chaktomouk,* meaning"four-faces". Commercial fishing is allowed in most areas of the Lower Mekong and Tonle Sap Rivers and the Tonle Sap Lake. The Lower Mekong River covers a vast wetland area that is an important aquatic and water bird habitat. Several calmatages and small rivers carry nutrient enriched silt and water to the wetland areas. There are approximately 35,000 km^2 of wetland in Cambodia: 20,000 km^2 along the Mekong and 15,000 km^2 around the Tonle Sap Lake (Baran 2005).

c. Tonle Sap River and Tonle Sap Lake

The Tonle Sap Lake is the richest wetland ecosystem in the world (Neou 2001). The unique hydrological regime of the Tonle Sap River and the Mekong River play a significant role not only in the perpetuation of productive biodiversity, such as fish, wildlife and forest, but also in the present land use pattern and diverse cultural landscape. Recognising the ecological, economic and socio-cultural values of the Great Lake, UNESCO listed it as a Biosphere Reserve in 1997.

The hydrological cycle determines the filling up and draining of the Lake and the inundation of adjacent forest areas, during which time its depth increases from 1-2 m up to 10 m and its surface area expands from 3000 km^2 to 10-14,000 km^2 (Thuok 2009). The flooding of the forest around the Lake releases large amounts of nutrients into the water and provides food that is not generally available to the fish. This is the breeding time for fish, when the greatly increased area of flooded forest provides an ideal habitat for spawn and fingerlings and food is plentiful.

Table 5: Tonle Sap Lake Habitats, Area (ha) and Distribution (%)

Type of wetland or water resource	Area(ha)	Percent
Water surface	276,400	15.80
Marsh/swamp	1,500	0.10
Grassland	152,100	8.70
Shrub-land	215,000	12.20
Flooded forest	495,300	28.30
Rice field	515,000	29.40
Other	95,400	5.50
Total	1,750,700	100.0

Source: FiA 2009

Table 6: General Assessment of the State of Cambodia's Inland Fisheries

Locations	General assessment
Upper Mekong River and its tributaries, the Sesan, Sre Pok and Sekong Rivers	• Protected breeding ground for freshwater fisheries resources. • Several deep pools are vital habitats for deep pool fish, particularly globally endangered species. • No large-scale fishing or commercial fishing or fishing lots are allowed. • Hydropower dam development could challenge sustainable fisheries management, especially rare deep pool species and big fish. • Hydrological changes might lead to changes in ecosystem services and water quality. • Unsustainable practices, and destructive fishing gear decimate fish population, degrade habitats and impact on local livelihoods. • Land use change in the Mekong watershed could adversely affect fisheries.
Tonle Sap River, Tonle Sap Lake and Lower Mekong River	• Encroachment on forest land for agriculture and cutting flooded forest for fuel wood have diminished habitats and breeding spaces for aquatic species. • Water quality changes are due to household waste, boat engine oil and agricultural runoff; accumulated waste could lead to eutrophication which would contaminate aquatic creatures. • Fishing has intensifies due to increasing number of fisher-folk. Increased catches of small fish might be a critical sign of declining numbers of large fish. • Commercially valuable fish have declined due to habitat degradation. • Fluctuation of water level may affect flooded forest along the Tonle Sap and Lower Mekong Rivers and around the Tonle Sap Lake.

d. Dam Development

A study by the Ministry of Industry, Mines and Energy reports that on the ongoing and proposed hydropower dams on the Mekong River and its tributaries in Mekong countries[20] will likely impact on the Mekong and Tonle Sap ecosystems, food security of rural livelihoods and natural resources reserves (MIME 2007). Energy is needed in all sectors; however, the production and transmission of energy will impact on the environment and ecology of surrounding areas. Goldsmith and Hildyard (1984) and McCully (1996) contend that the development of large hydropower dams will have serious consequences for the environment and society. Barrow (1998) argues that the impact of a large-scale hydropower scheme becomes even more complex when it is located in one country, but adversely impacts on a neighbouring country(cited in Fisheries Office 2000: 6).

> *Fishing activities usually occur in the dry season in the Sesan River. Fish catches are gradually declining and water levels fluctuate more widely. Ten years ago, prior to the construction of the upstream dam, the Sesan River was rich in fish. We used to catch up to 20 kg a day, but now it is difficult to catch anything. We were told that the upstream hydropower dam has caused the change of water regime in the Sesan River. A proposal to build a new dam in the area is of great concern to us. The construction site is just a few kilometres downstream. We are worried about the construction of a cascade that*

20 Cambodia has also proposed several dams on the Upper Mekong's tributaries in the North-east. Feasibility studies have been done on at least seven or eight sites, for instance, Sambor Dam (2600 MW), Lower Sesan II (400MW), Lower Sesan III (375MW), Sre Pork III (300MW), Stung Treng (980MW) and Stung Pursat (100MW), Stung Sen (38MW) and Stung Battambang (36MW) in the Tonle Sap catchment. The electrification level in Cambodia is just 20 percent compared to 84.2 percent in Vietnam and 99 percent in Thailand.

may flood the villages located upstream... (farmers at FGDs in Phum Mouy and Phum Pi villages, Srekor commune, Stung Treng province, 2011).

It is expected that dams will store water during the monsoon and thus decrease wet season flood levels. In Wat village, Kompong Khleang commune, Siem Reap province, villagers said that the declining fish catch is due to the increasing number of fishers. They believe the Tonle Sap Lake is becoming shallower as a result of dam construction on the Upper Mekong River.

e. Results from FGDs and Observations

One of the study sites in Kompong Khleang commune, Siem Reap province, is located deep in the Tonle Sap Floodplain. Fishing is a major occupation and main income source for the majority of villagers there. Previously, the area had plenty of big trees, dense forest, flocks of waterfowl and pools and lakes that did not dry out during the recession or dry season. Now, the number of locals involved in fishing has increased and crop farming, especially rice and cash crops (green beans, corn), has become an equally important source of income as fishing. Information from the FGDs and researchers' observations is summarised below:

- Major activities are freshwater fishing and crop farming. Rice and other cash crops are cultivated to supplement subsistence. The water level rises by 6 to 10 m during the wet season when only family-scale fishing is allowed.
- Most villagers are allowed to use the plot of land (maximum length 200 m) behind their houses for crop cultivation; however, ownership of these plots is not registered – villagers can use the land but not sell it. Traditional materials and generator-run water pumps are used for crop cultivation. The soil is fertile and soft and though chemical fertiliser is applied to fruit crops, it is not used for soil improvement.
- Fish catches are changing; fish are smaller and the size of individual catches has been decreasing. Two or three decades ago fish were plentiful, especially big fish. Fisher-folk believe that today's poor catches are related to the loss of flooded forest, i.e. diminished fishing ground. Changing rainfall pattern might have affected water levels in both up- and downstream areas of the river basin. Fisher-folk believe that changes in upstream water flow could adversely impact on downstream areas like the Tonle Sap Basin, particularly freshwater fisheries.
- Fisherfolk have to have extra jobs, for instance, growing rice or cash crops to support their livelihood or small savings. Previously, fishing alone could support livelihood needs.
- Villagers sometimes grow two crops a year depending on the water level. The first crop is grown in February to April, but a second cultivation is risky. They can harvest a second crop if the cultivation area floods in late July or August, but floods before July could damage all kinds of crops. Fisher-folk said water levels occasionally rise in June or July. However, the change in water level in recent years has allowed villagers to engage in rice double-cropping.
- Fisher-folk are aware that fisheries resources have decreased since 2000. Most pools, ponds and lakes are either pumped dry or dry out in the dry season. Furthermore, most fishers occasionally use illegal equipment. By law, 4 cm mesh net is allowed for family-scale fishing, yet most fishers confess to using nets with 2 cm mesh. Fishers said their daily catch varies from 2 to 3kg and sometimes they net 5 kg.

- That the waterfowl population has markedly declined is a significant indicator of fish stock depletion; lack of food has forced waterfowl to move elsewhere. Fluctuation in water levels associated with higher temperatures and changes in rainfall distribution have diminished aquatic habitats.
- Most respondents heavily depend upon agricultural crops as their major source of livelihood or income, especially in areas where access to sub-forest or forest to collect wood and NFTPs is accessed limited.

4.6. Forest Resources

The forest resources sub-sector is considered important to the overall agricultural sector because of its present and potential contribution to economic growth. Given Cambodia's tropical climate and rich endowment of natural resources, the sub-sector holds vast potential if managed effectively. Renewable forest resources[21], along with water and fisheries resources, play a significant role in sustaining livelihoods. Approximately 80 percent of Cambodians live in rural areas where natural resources and agriculture have been the main sources of subsistence for generations. Indigenous and non-indigenous communities are almost entirely dependent on forest resources and forestland (Schweithelm *et al.* 2006). The forest enables them to raise their standard of living beyond simple subsistence (Licahdo 2005)[22]. Moreover, forest resources and land are deeply connected to their spiritual beliefs and culture (UN 2007).

Economic land concession (ELC) companies are said to have generated jobs i.e. income earning opportunities for the local populace. But livelihoods dependent upon labouring for an ELC developer[23] are not better than those largely based on collecting NFTPs. In terms of money, villagers get more from waged labour than from collecting and selling/exchanging forest products but their wage cannot support family livelihood. Because they are required to work full-time there is little to no time for collecting forest products, growing or making things, so they have to buy everything[24]. This is consistent with information from the FGD in Krayea commune, Kompong Thom province, where villagers expressed deep concern over denied access to the forest. The forest area they used to rely on for resources has been granted to an ELC for rubber plantation and they have been banned from entering the forest since 2010, so they now have no choice but to sell labour as workers for survival.

When forestland is converted, all forest resources are lost forever and communities face uncertain livelihood options; they will have hardly any choice and their subsistence will be substituted by paid labour. In addition, they will lose their freedom to earn and live according to cultural traditions. The FGD confirmed that villagers are well aware of the livelihood

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21 The CMDG of maintaining forest cover over 60 percent of the country's total land area is addressed in the National Forest Policy as set in NSDP 2006-10.

22 Conflicts have occasionally erupted between Economic Land Concession (ELC) developers and local communities that live in the vicinity of the licensed forest area.

23 At the time of study there were 85 contracted and validated ELC companies with total land area of 956,690 ha located in 16 provinces (MAFF 2010c). Most of the ELCs are licensed to invest in agricultural or agro-industrial crops such as rubber, cassava, sugarcane, oil palm and other tree plantation e.g. Acacia, Tectona, Pastacia chinasis and Merkusii. Rubber trees and cassava are predominantly grown in ELC areas. Many ELC companies have not started cultivation, yet selective cutting for timber is going in these areas. In April 2011 the prime minister cancelled 14 ELC contracts (14 companies) and turned the land over to state ownership or new developers/investors (workshop on the Overall Annual Report on Agriculture, Forestry and Fisheries 2010-2011 and Targeting for 2012, April 2011).

24 Community people have been vocal in expressing their concerns about forest resources, protesting against rubber plantation companies in Prey Long Forest Area, Tum Ring commune, Sandan district, Kompong Thom province (*Radio Free Asia,* 3 March 2011).

hardship they will face when the forest is gone. The villagers also realise the environmental impacts of forest clearance i.e. irregular rainfall (rains start late, less rainfall), higher than usual temperatures, and soil erosion. (See Table A1: Statistics of ELC).

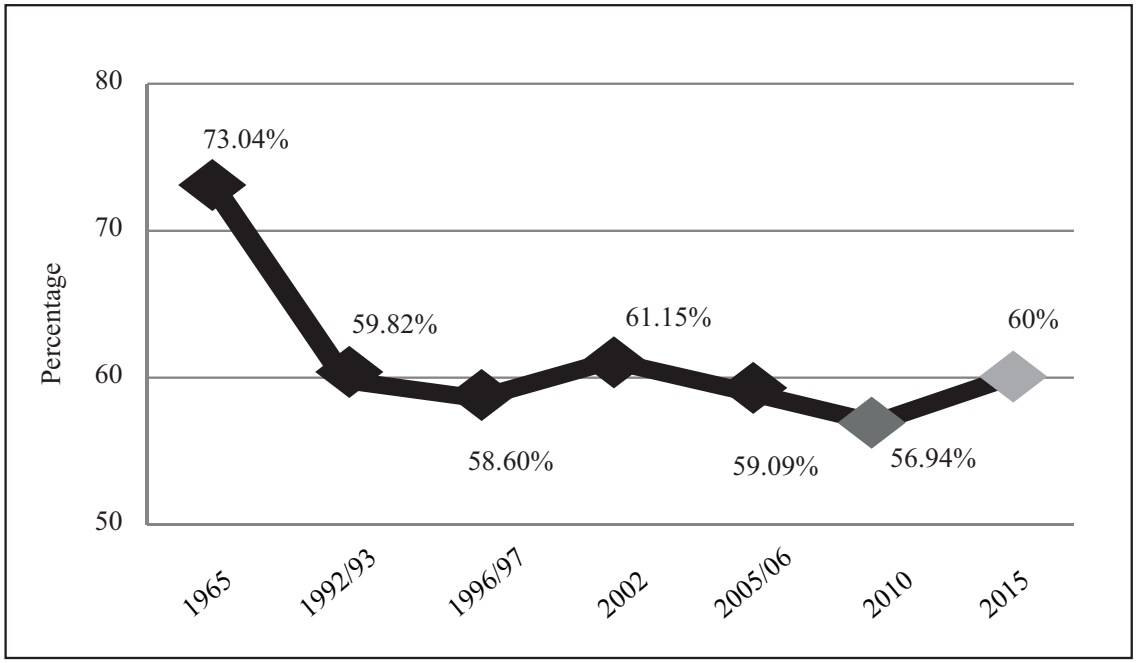
Table 7: Changes in Forest Cover, 1965-2010

Year	Land use			
	Area with forest cover		Area without forest cover	
	Ha	Percentage	Ha	Percentage
1965	13,227,100	73.04	4,883,400	26.96
1992/93	10,859,695	59.82	7,293,290	40.18
1996/97	10,638,209	58.60	7,514,776	41.40
2002	11,104,293	61.15	7,056,383	38.85
2005/06	10,730,781	59.09	7,429,893	40.91
2010	10,339,826	56.94	7,820,848	43.91

Source: FA 2010

The forest resources sub-sector has a vital function in contributing to environmental protection and socio-economic development. Expanding agricultural land may provide long term development, also contributing to economic growth. Diversifying job opportunities within the agricultural sector would help reduce unemployment and poverty. On the other hand, further decline in forest cover could have significant impacts on overall ecological services (Table 7). The extent of forest cover has a recently dropped to 56.94 percent against the CMDG of 60 percent.

Figure 15: Changes in Forest Cover, 1965- 2010



Source: FA 2010

In this general assessment of forest resources' contribution to the agricultural sector, three main aspects are considered: livelihood, economy and ecology.

Livelihood

Present agricultural development efforts to ensure national food security and promote rice export have expanded cultivated areas[25]. Diminishing forest resources are gradually increasing the pressure on livelihood sources, especially for forest dwellers whose subsistence depends on access to diverse forest resources[26].

From geographical and demographic growth aspects, intensifying agricultural production, especially to increase rice production, could be potentially important to ensuring food security. This in turn could contribute to either protecting forest resources or improving forest dwellers' poor living conditions. Indigenous people are the most directly dependent on forest resources. Their livelihoods and cultures are intimately associated with the forest, and their way of life is threatened by the spread of settled agriculture. NTFP such as bamboo shoots, wild leaves, resins, medicinal plants, mushrooms, honey, rattan and lianas and other construction materials are significant resources for daily subsistence. The extent to which people can use forest assets to build a livelihood depends on the institutional arrangements which define rights and access to the forest and the way those rights are curtailed by others in more powerful positions (FA 2004b: 10).

Economy

The forest sub-sector has contributed to national revenue. It has also contributed to the economy in other ways including as a source of wood and non-wood products for construction and furniture making. Timber products are commercially important for furniture manufacturing. Other NTFPs[27] are also important for livelihoods and market. At least 50 percent of NTFPs are economically and commercially important for community livelihoods and market trading. Estimated value of rattan is approximately USD2 million while the annual honey yield of 400 to 500 tonnes has a domestic value of USD3.5 million. Sustainable forest management approach would be a viable option to maximise long term benefits of forest resources.

Ecology

Forests are crucial habitats for diverse species of wildlife, and different forest types provide a variety of habitats. Cambodia has vast areas of evergreen, semi-evergreen, deciduous and mangrove forests[28] which support many species, for instance, large and small mammals, reptiles, amphibians, birds and insects. The forest also functions as an ecosystem service and helps regulate the environment. The extent of deforestation/degradation due to rampant logging, land grabbing, speculation and fragmentation for development poses a critical challenge to the sector's contribution to economic development, poverty alleviation and biodiversity protection.

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25 The cultivated area, including both wet season and dry season rice, stands at nearly 3 million ha with total rice production of 8.25 million tonnes MAFF (2011b). One of the CMDGs is to increase milled rice export to 1 million tonnes by 2015 (MAFF 2011a).

26 Forest dwellers occasionally face rice shortage as their own-grown rice might only be enough for six-months of the year, which is why NTFP collection is critically important for their daily subsistence (K. Eang Hourt's presentation at the International Conference on "Managing Forest Resources for Multiple Ecosystem Services under Robust and Fragile Environment", Phnom Penh, 2010)

27 K. Eang Hourt, presentation handout at the International Conference on Managing Forest Resources for Multiple Ecosystem Services under the Robust and Fragile Environment, 2010.

28 Mangroves line nearly two-thirds of Cambodia's coastline, often forming narrow fringes along sheltered spots and reaching the most extensive development in estuaries and wide river mouths. Most of these mangroves appear to be affected in some way by human activity (MoE & Danida 2006). In 2005 the total mangrove area was approximately 55,419 ha (MoE & Danida 2007: 62).

To summarise, protecting the forest means goods and ecosystem services can be generated in the long term. The forest contributes to agricultural development not only by generating national revenue and directly supporting the daily subsistence of forest dwellers - especially indigenous communities, it also secures biological diversity and conserves the environment. Land use change is the result of the conversion of forest area through several forms for development, for instance, ELCs[29], agro-industrial crop plantations such as rubber, oil palm, cassava and jatropha (*Jatropha curcas*). If ELCs are fully exploited then they will be a significant driver of the agricultural sector's contribution to national economic development.

29 ELCs can be granted forested land located both within and outside protected areas. The MoE is responsible for protected areas and MAFF is responsible for areas that are not protected.

5

Access to Credit and Market

5.1. Credit

An ADB study identified a significant gap in rural credit supply and the fragmented captive nature of the rural credit market, where interest rates charged by microfinance institutions (MFI) and commercial banks are high even compared to informal lenders' rates (ADB 2008). As noted in a World Bank report, lack of access to formal credit forces many farmers to rely on informal sources of financing at very high interest rates (Guimbert 2010). A study by the United Nations Development Programme (UNDP) found interest rates as low as 5 percent a month for informal credit where competition exists, and higher rates where it does not (UNDP 2007). Short loan repayment periods, conditions and procedures, including collateral requirements, are not conducive to borrowing by poorer clients. The crop production credit market is almost entirely controlled by middlemen, with collectors and (agricultural) input merchants accounting for over one half of rural credit business in Cambodia (ADB 2008). Personal and emergency loans as well as production credit are extended by moneylenders. Banks, NGOs and MFIs account for 10 percent of rural credit which is mainly directed to capital investment, business and farm working capital. In 2007 there were ten commercial banks, 17 licensed MFIs, and 25 registered and 60 unregistered NGOs providing microfinance services (ADB 2008). The major MFIs and commercial banks that provide services in provincial centres and districts are listed in Table A3.

MFIs such as Amret that extend services to villages and lend to small farmers charge 2.5 to 3.5 percent a month interest, while established rice millers pay 1.5 percent a month for a short term dollar loan from commercial banks. Increased access to credit at lower interest rates would help farmers buy inputs for both seasonal and longer term production, but lower rates must come from competition rather than subsidies (UNDP 2007). Borrowers frequently combine farming with trading or agricultural processing. These loans are not tailored to the cash flow of a specific crop, but are repaid at a constant rate.

A UNDP (2007) study on rural incomes in Cambodia notes that Amret tends to make loans in smaller amounts to those whose main or only activity is farming. Loans are issued and repayments made in the village, and the repayment schedule is more often tailored to the cash flow generated by a crop. Given MFIs' focus on serving poorer customers, it would be appropriate to allow them to compete with commercial banks, providing risk is controlled and recognised and that there is no unfair bias. It is important to understand the difference between a progressive commercial bank such as the Association of Cambodian Local Economic Development Agency (ACLEDA) and a MFI such as Amret. Both institutions lend to rural households, compete with informal credit and offer better terms (UNDP 2007). (See Table A3: List of Microfinance Institutions and Commercial Banks in Cambodia.)

Field observations and FGDs confirmed that farmers can sell their rice crop to middlemen while it is still standing in the field. Farmers hire labourers or machines (harvester, thresher) to harvest the crop and then sell the rice direct to middlemen who, using their own means of transport, collect the rice from the fields. Rice usually fetches a lower price when sold in the field compared to the general market price. There are several reasons why farmers might

prefer this arrangement, mostly concerning farmers' issues around credit and debt[30]. Farmers can pay off their debts as soon as they have sold their rice. Although MFIs offer cheaper loans compared to middlemen who charge around five to seven percent interest a month, they demand the deposit of collateral to secure the loan. Middlemen have a multiple role i.e., moneylender, buyer, , service provider for machine hire, transport and pumping water. Some middlemen are in business as rice millers.

Middlemen can be local villagers or outsiders and are classed as small or big[31]. Generally, they concentrate their business on a zone in a particular area. Small middlemen sell the produce they have purchased to big middlemen according to mutual negotiation or contractual agreement. Most farmers their sell rice to small village middlemen or outsiders who come to the village to buy. Some farmers transport their rice to sell to big middlemen at a slightly higher price compared to the village price, though they still get very low benefit when transport costs are taken into account.

Rice prices vary slightly from one place to another within a province, or between different provinces. Prices range from 800 riels[32] to 1000 riels to 1200 riels per kg, depending on the rice variety. Price variations for the same rice variety are a bit different; for instance, the price of rice in a particular part of Pursat province is 200 to 300 riels per kg higher than in Kompong Thom province. Sometimes price also depends on the distance small middlemen have to transport rice in order to sell it on to big middlemen.

During the FGDs it was revealed that debt-free farmers can withhold their rice and delay selling it until the price is good or they can lend it to neighbours at a good rate of monetary return. Rice prices fluctuate during and after harvest; the price after harvest can be 100 to 200 riels per kg higher or lower than during harvest-time. Generally, rice prices vary from year to year with differences ranging from 100 riels to 300 riels or 500 riels per kg, depending on rice variety. Price is defined by the market or big middlemen. It is also defined (on paper) by state institutional authorities. This tends to be slightly higher than the market price, but in reality farmers rarely get such a sale. Rice prices should be constantly monitored and evaluated so they can be properly taken into account.

Small middlemen transport the rice they have purchased to sell to big middlemen at the nearest location or district town where they can get the best price. Middlemen get a slightly higher price than what they paid the farmers. This can be considered a significant constraint factor which could discourage farmers from selling directly to big middlemen. Farmers sell most of their rice and only keep enough to cover or supplement their subsistence in the next season. Farmers who grow commercially valuable rice seeds for the market sell their entire yield and then buy in rice at a lower price.

Access to finance is a stronger constraint for agriculture and as recorded by the NBC, as of 2008 only 5 percent of the total national loan portfolio was invested in agriculture (World Bank 2010). In addition, about one million rural households borrowed USD200 million, as

30 Farmers often borrow inputs (i.e., seed, plough, water pump) and rental is calculated in monetary value. Farmers borrow money from village middlemen, neighbours or relatives at interest rates fairly similar to or higher than those charged by MFIs. However, repayment terms are flexible and debts can be paid off in the short or long term. Farmers usually pay off their debts within six to 12 months of harvesting. But if yields are low, due to natural disaster for example, they will face a critical situation in terms of debt payment or food shortage.

31 Big middlemen have several rice mills with large warehouses located within reach of their businesses.

32 Exchange rate (July 2011) USD1 is 4030 riels, quoted at: http://www.everyday.com.kh/services/exchange_rates/defaultkh.asp (accessed 29 July 2011)

recorded by the NBC in 2006 (ADB 2008). Size of loan varies from a few dollars to USD5000 or more. Processors or traders have easier access to formal credit than farmers and fishers, though the formation of village banks and self-help groups has helped improve the latter's prospects of obtaining formal credit (ADB 2008).

A World Bank study (2010) observes that lack of access to formal credit is the major reason for rice millers' lack of working capital and the country's outdated rice milling technology, and emphasises that loan repayment terms are not flexible enough for investment in long-term agricultural production, agro-forestry in particular. FGDs confirmed that it is better for farmers to borrow money or inputs for cultivation through informal credit arrangements. Most of the borrowed money or inputs, for instance, fertiliser, gasoline for water pumps or hired labour are essential for improving rice productivity. Farmers may have to postpone repayment if crops are damaged by natural shocks (flood, drought, cyclone, pest infestation). Such challenges can push farmers deeper into debt for long periods of time and force the sale of assets.

Cambodia is rich in water resources, yet water is also considered an economic scarcity. Lack of irrigation infrastructure is a major input constraint for more extensive water allocation. Expansion of irrigation is the only means of diversifying and intensifying crop production e.g. double or triple-cropping. Most of the existing irrigation schemes are incomplete and only have sufficient capacity to provide supplementary water to tide rice cultivation over the short drought that occurs in the middle of every wet season.

Other critical constraints include low technical knowledge on how to use inputs effectively and efficiently, e.g. fertiliser application, choice of seed variety. Better awareness of how to use inputs properly would help improve productivity. Further, disseminating knowledge about farming methods, such as crop husbandry, water monitoring and pest/infestation control is crucial. FGDs revealed that most farmers lack the technical skills and knowledge they need to get better results from their farming.

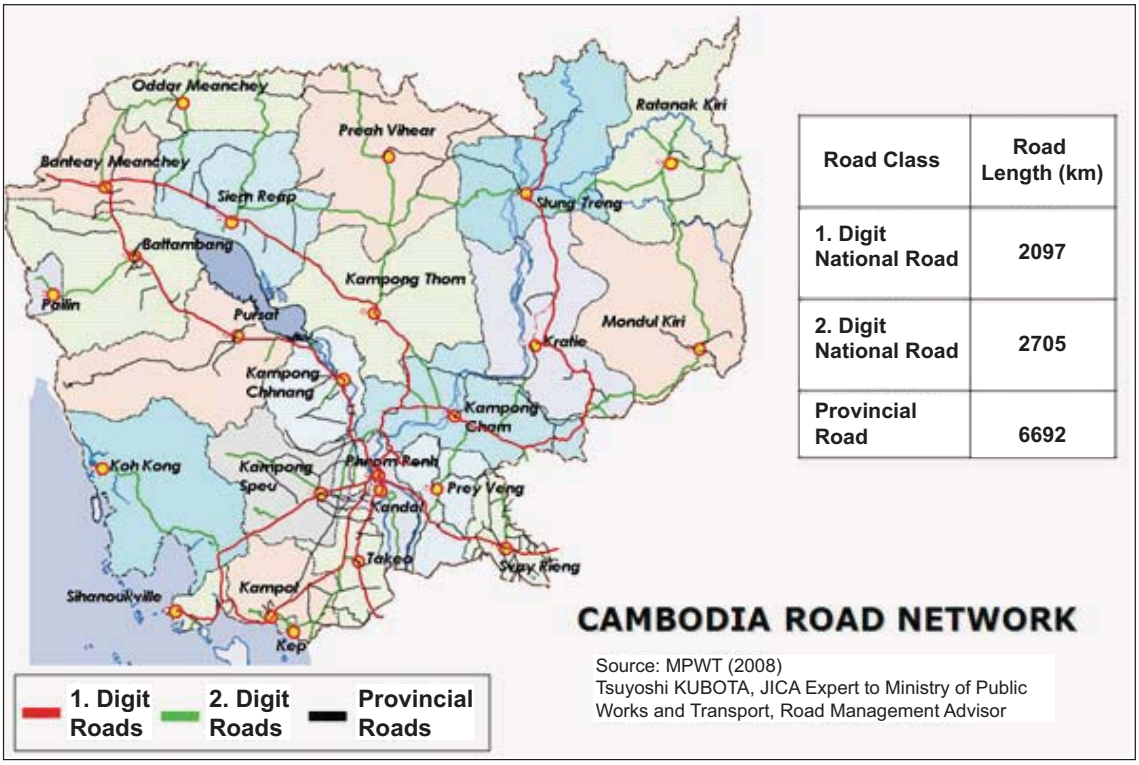
5.2. Infrastructure

The road network has been significantly upgraded. The national highway system has been completed and the paving of secondary roads should be completed by 2011 (World Bank 2009). Roads carry two-thirds of all passenger traffic and cargo transport. Road density and the proportion of paved roads are still low. Priorities are therefore shifting to road maintenance and tertiary (farm to market) roads (World Bank 2009). Further, field observations confirm that most roads, especially district and village roads, are connected to nearby markets in the district centres. Majority of village roads have been improved through provincial funding[33] or the decentralisation and deconcentration programme of the National Committee for Sub-national Democratic Development (NCDD).

FGDs confirmed the importance of road networks for villagers to access markets or seek temporary jobs in nearby areas. Villagers said that during the harvest season, people move from downstream areas of the Lower Mekong or Tonle Sap Plain to seek work in the Highland areas of Kompong Cham, Ratanakiri and Modulkiri provinces where they are hired to harvest cassava, soybeans, sesame and rubber. The better road network also makes villages accessible to middlemen whose business makes a critical contribution to local livelihood improvement.

33 Most of the provincial fund comes from the national budget, ruling party or generous donors.

Figure 16: Cambodia Road Network, 2008



Road Class	Road Length (km)
1. Digit National Road	2097
2. Digit National Road	2705
Provincial Road	6692

Source: Sun 2008

Infrastructure rehabilitation and development is one of the pillars of the government's Rectangular Strategy (Figure 16). Infrastructure plays an important role as one of the "locomotives of economic growth and as an effective means for poverty alleviation" (Sun 2008). It was observed that farmers can get slightly higher benefit from selling their agricultural produce in areas near border corridors, compared to areas further away. Although the road network has improved access to remote areas, farmers still get lower benefit because of transport costs and additional expenses.

Most district centres are located along national roads or provincial main roads. Distances between district centres and provincial towns vary (Figure 17). Sre Ambel district centre is about 148 km from Koh Kong town. Most of coastal district centres in Koh Kong province can be accessed via waterways or land routes. Koh Kong town is located next to the border crossing with Thailand which is an important trade and smuggling route.

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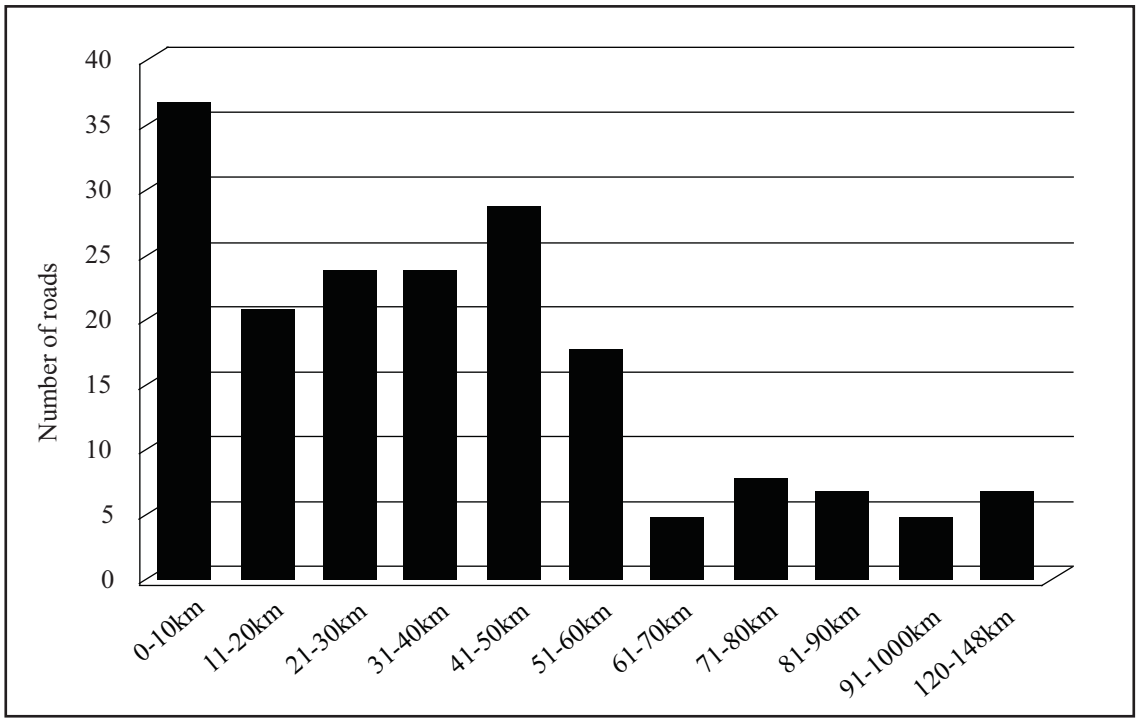
Figure 17: Distance between District Centres and Provincial Towns (km)



Source NCDD 2008

The study sites are accessible via main roads. Fourteen districts are located 90 km to 148 km from the provincial towns, and they are also connected to the border. Majority of goods are exported or imported through border corridors. Districts located close to roads or that have road access to borders i.e., with Thailand, Vietnam and Laos, can take advantage of trading opportunities, particularly in agricultural goods. Coastal districts have potential for ecotourism, tourism areas, fishing and shipping. There is an international deep seaport at Sihanoukville, which is about 226 km from Phnom Penh along National Highway No 4. There are also two railways (Figure 18). The 264 km Southern Line, constructed in1960-1969, goes from Phnom Penh via Kep and Kampot provinces and connects with the seaport in Sihanoukville,. The 386 km Northern Line, constructed in 1929-1942, goes from Phnom Penh to Poipet, passing through Kompong Speu, Kompong Chhnang, Pursat, Battambang and Banteay Mean Chey provinces before connecting with the railway in Thailand.

The government of Cambodia has outsourced its railway operations under a 30 year exclusive concession to Toll (Cambodia) Co., Ltd (trading as Toll Royal Railway34). The ADB and AusAID have agreed to fund (USD140 million) the upgrading of the existing rail network and infrastructure.

34 www.tollroyalrailway.com (accessed 15 August 2011).

Figure 18: Cambodian Railway Network

Source: Sun 2008

Field observations confirmed that every district is served with main roads, whether bituminous, laterite or earth. Forty six districts are directly or indirectly affected by cross-border business. These districts depend upon the trading of goods, and majority of farmers benefit from selling their agricultural produce, (rice, cassava, soybeans, and maize). Table 8 shows the number of districts influenced by cross-border trade.

Table 8: Road Network Access to Border Checkpoints

Access to borders	Remarks
Cambodia-Laos corridor	• Small- or family-scale trade and smuggling. • Most goods are imported via Laos and are of Lao or Thai origin. Main border checkpoint is in Thalaborivath district, Stung Treng province. • A potentially important route (450 km long) for tourism being located in the northeast and easily accessed by National Road No. 13. • Two districts have access to the border checkpoint in Stung Treng.
Cambodia-Thailand corridor	• Small, medium and large-scale trade and smuggling. • Majority of exports originate in Cambodia, e.g., agricultural produce such as rice, cassava and maize. • Majority of imports include consumer goods, cement, agricultural machinery, fertilisers and electronic goods. • Of the several main gates at the Cambodian-Thai border, the most significant one is in Poipet district, Banteay Mean Chey province. There are seven major border checkpoints located in different provinces: Battambang, Banteay Mean Chey, Pailin and Koh Kong. These checkpoints are also important for travellers/ tourists. • Most popular border checkpoints are Poipet (Banteay Mean Chey) and Cham Yeam (Koh Kong); Cham Yeam checkpoint can also be accessed from the coastal provinces via water way. • At least 26 districts can access border checkpoints.
Cambodia-Vietnam corridor	• Most important border checkpoint for both goods and passengers is in Bavet district, Svay Rieng province. Other border checkpoints are important for small-scale and family-scale trade, especially rice, cassava, soybeans and rubber. • Another important gate is in Memout district, Kompong Cham province where the majority of exports are agricultural goods, e.g. cassava, soybeans and rubber. • Most districts located in or having access to the northeast are connected to these border checkpoints. Districts located in the west, northwest and southwest can transport goods to Cambodian-Thai border checkpoints. • Traders in 18 districts can reach the border, especially those located nearby.
Seaport, international airports and railway network	• Sihanoukville international seaport is important for shipping; it is the only seaport for import and export. • International airports, in Siem Reap province and Phnom Penh, serve as international hubs for tourism and cargo. • Railways: (1) from Phnom Penh via Kep and Kampot provinces to the seaport in Sihanoukville; (2) from Phnom Penh to the west, passing through Kompong Speu, Kompong Chhnang, Pursat, Battambang and Banteay Mean Chey provinces to connect with Thailand's railway. • At least 29 districts can use the railway for transport and market access.

Source: MPWT 2008

6

Climate Constraints to the Agricultural Sector

Many schools of thought in the literature give different insights and perceptions on climate change. The National Oceanic and Atmospheric Administration (NOAA 2008) defines climate change as a long-term shift in weather norms (including its averages)[35]. It can be seen for a given place and time of year, from one decade to the next, as a change in normal climate (i.e. expected average values for temperature and precipitation). Climate change can be caused by: 1) natural variability, i.e. it is a normal part of the Earth's natural variability, which is related to interactions among the atmosphere, ocean and land, as well as changes in the amount of solar radiation reaching the earth; and 2) human-induced change, especially the greenhouse gases[36] resulting from natural phenomenon and the burning of fossil fuels which releases gases[37] that trap heat in the atmosphere.

Even a slight increase in temperature across a country or a region will increase the overall temperature of the world for the next centuries. The United Nations Environment Programme is based on the premise that "climate change is the defining challenge of our generation and it is no longer relevant to discuss whether or not our climate is changing, but rather, how fast changes will occur" (UNEP 2009). The National Climatic Data Centre reports that atmospheric concentrations of both natural and man-made gases have been rising over the last few centuries. Due to its increasingly unpredictable and alarming impacts on the environment and human beings, climate change is now universally acknowledged as a global issue which requires all countries to work collectively to mitigate the problem under bilateral, regional and international frameworks.

Cambodia has frequently suffered catastrophic damage from natural disasters, notably drought, flood, storm and after-effects such as flash floods (e.g. cyclone Ketsana in 2009), particularly in the many rice producing provinces in the Tonle Sap Lowlands and along the Mekong River. The majority of the rural poor rely on the regularity of the wet and dry seasons, especially for crop farming, which affects all aspects of their lives from income generation, consumption, nutritional status, education and health (RGC 2002b: 42). The agricultural sector is especially hard hit by natural disasters; not only crops, but infrastructure, buildings and equipment are destroyed. Given that the agricultural sector is a key contributor to the national economy, the impact of natural disasters reverberates beyond its confines. The Strategy for Agriculture and Water (SAW 2007: 6) highlights natural disasters as one of nine major factors that pose potential threat to Cambodia's agriculture and water sectors (TWGWA 2007).

6.1. General Overview of Cambodia's Climate

Cambodia is located on the south-western part of the Indochina peninsula, between 10° to 15° north latitude and from 102° to 108° east longitude. It is bordered by Thailand to the west and north, Laos to the north, Vietnam to the east and south, and the Gulf of Thailand

35 The "normal" of a particular variable, e.g. temperature, is defined as the 30-year monthly average minimum temperature, based on NOAA data: http://www.ncdc.noaa.gov/oa/climate/normals/usnormals.html#WHATARENORMALS (accessed 21 July 2011).

36 Many greenhouse gases (e.g. carbon dioxide, methane, water vapour and nitrous oxide) occur naturally in the atmosphere, while others (e.g. chlorofluorocarbons, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (SF_6)) are synthetic; based on National Climatic Data Centre, http://www.ncdc.noaa.gov/oa/climate/gases.html (accessed 21 July 2011).

37 Ibid.

to the southwest. Cambodia is a low lying country and rich in water resources. The Mekong River supplies surface water to the eastern part of the country while the Tonle Sap River Basin supplies the central and western parts.

Cambodia has a tropical monsoon climate, dominated by southwest monsoon (mid-May to October) and northeast monsoon (October to April) (Khun 2002). The monsoon climate creates two main seasons: the wet season runs from May to November when the average temperature is 27°C to 35°C; the dry season is from November to February, and the average temperature ranges from 17°C to 27°C. March to May is the hottest time of the year with temperatures of about 29°C to 38°C (Khun 2002). Humidity is 65 to 70 percent in January and February, and 85 to 90 percent during August and September. Annual evaporation is 2000-2200 mm, with the highest in March and April at 200-240 mm per month, and the lowest in September and October at 120-150 mm per month. Monthly average evapotranspiration is about 120 mm in the dry season and 90 mm in the wet season (Chann 2002).

Farmers cultivate rice in both dry and wet seasons. The rice cultivated area has expanded annually over the last two decades. Average rice yield in 2008 was reportedly about 2.2 tonnes per ha in rain-fed or non-irrigated areas and 3.2 to 3.5 tonnes per ha in irrigated areas (MOWRAM 2009). MAFF data record that the average rice yield in 2010 was about 4.2 tonnes per ha in the dry season and 2.76 tonnes per ha in the wet season (MAFF 2011a:19). Most agricultural areas are rain-fed. Farmers still rely on rain-fed agriculture and grow one crop per year. The average annual rainfall is 2000-3000 mm in the Mountainous area, 4000 mm in the Coastal area and 1400-1600 mm in the Plains area[38] (Khun 2002).

Rice, maize, cassava, soybeans and mung beans are the main crops grown in Cambodia. Given the country's fertile soils, vast arable land and plentiful water resources, there is great potential to increase rice production. Rice is the staple food accounting for 68-70 percent of daily calorie intake (Mak 2004) and is important for national economic development. Government, the private sector and donors have provided new varieties of high-yielding rice seed, fertilisers and extension services to help train farmers in new technologies and methods to increase rice productivity (Hegadorn 2011). Efforts are being made to diversify crop production and encourage development of agro-industry plantations. Agricultural production offers potential for long-term development and sustainable rural income (MAFF 2011d). Agro-industrial plantations of rubber, cassava, sweet potato, sugarcane and oil-palm have been established in ELC areas in 16 provinces. Based on national agricultural statistics, the agricultural sector's share in GDP by 2010-end (at constant 2000 prices) was about 29 percent (MAFF 2011a). Even though Cambodia encounters less natural disasters per annum than its neighbouring countries, its limited adaptive capacity makes it particularly vulnerable to the impacts of global and regional climate change (Arief & Herminia 2009). Historically, the country has suffered many natural disasters including the drought in 2002 (419 people affected) (Khun 2002), floods along the Mekong River in 2000 (347 deaths) (MOWRAM 2010), storms and the after-effects such as flash floods (e.g. cyclone Ketsana in 2009 which left 43 dead[39]). These disasters caused loss of life, destroyed social infrastructure and severely damaged agricultural production in rural areas (Khun 2002).

38 This includes areas around the Tonle Sap Lake and Lower Mekong River.

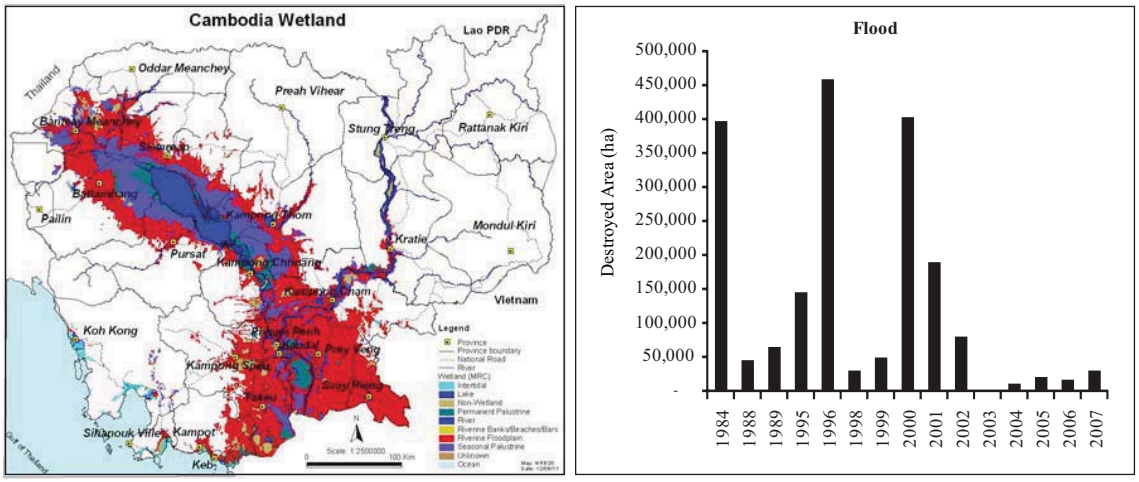
39 Typhoon Ketsana, Impact on Cambodia:.http://en.wikipedia.org/wiki/Typhoon_Ketsana#cite_note-53 (accessed 16 March 2011)

6.2. Flood

Agricultural areas, especially the Tonle Sap Plain and areas along the Upper and Lower Mekong Rivers are affected by floods for several months every year. The flooding of the Mekong River is a vital part of the natural cycle. Monsoon rains flow down to the Mekong and Tonle Sap Rivers and swell the Great Lake to about four times its dry season size (MRC 2002). For one to four months, the lowlands around the Tonle Sap Lake and the Upper and Lower Mekong areas[40] are inundated with water. This ecological phenomenon is an important source of water and nutrients for soil fertility for agriculture and for fisheries biodiversity. These impacts complement farmers' annual food production and food security.

Flash floods occur in areas around the Tonle Sap Lake, the Mekong River and its tributaries, often with devastating consequences for agricultural crops, livestock and fisheries, transport and infrastructure, housing and health. Such floods reportedly cause agricultural losses of USD100 to 170 million each year (RGC 2009). The estimated total damage and loss caused by Typhoon Ketsana in 2009 was about USD132 million (damage of USD58 million and loss of USD74 million); 14 out of 24 provinces suffered damage and destruction, and most of the affected districts are among the poorest in the country. Figure 19 shows Cambodia wetland area (left) and the extent of flood damaged paddy (right).

Figure 19: Map of Wetlands Floodplain and Paddy Damaged by Flood, 1984-2007 (Right)



Source: MAFF 2010b

Agriculture, infrastructure and human life can be seriously damaged by flood and flash floods. The Mekong River Commission (MRC), under three IPCC emission scenarios (A1B, A2 and B1)[41], projected that rainfall will increase during the wet season but remain unchanged

40 This includes Stung Treng, Kratie, Kompong Cham, Kandal, Kompong Thom, Kompong Chhnang, Battambang, Siem Reap, Prey Veng, Svay Rieng and Takeo provinces.

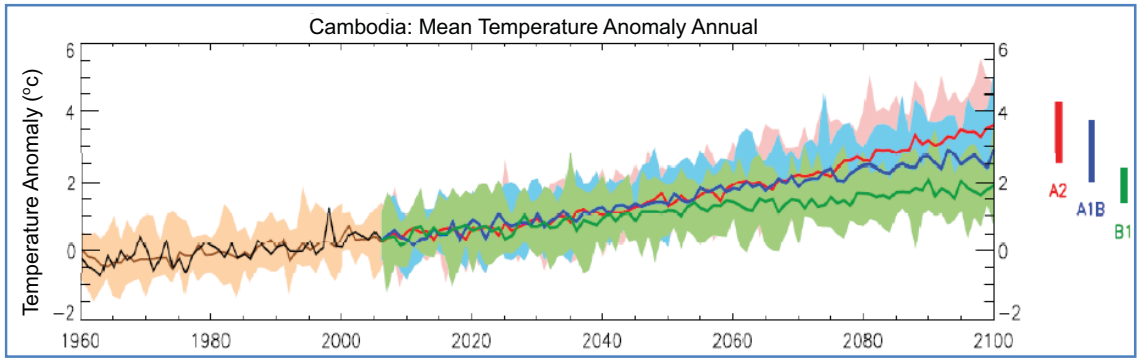
41 Four scenario families (A1, A2, B1, and B2), which represent the playing out of certain social, economic, technological, and environmental paradigms. were developed to facilitate the process of identifying and describing alternative future developments, *A1* storyline and scenario family describes a future world of very rapid economic growth, low population growth, and the rapid introduction of new and more efficient technologies; *A2* describes a very heterogeneous world in which economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines; *B1* describes a convergent world which emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives; and *B2* describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. See more on IPCC Emissions Scenarios at: http://www.ipcc.ch/ipccreports/sres/emission/index.php?idp=0

or lower in the dry season. This will create more flooding in the central agricultural plains, which are already vulnerable to flooding and drought (MRC 2010: 6-8). Since Cambodia relies mainly on the agricultural sector, serious decline in agricultural production could lead to more poverty and slow down national economic growth.

6.3. Drought

Frequent natural disasters, particularly flood and drought, have hit Cambodia over the last decade. Temperature has climbed steadily from one decade to the next. The MRC calculated that the average temperature in Cambodia increased by 0.8°C from 1960 to 2005; the rate of increase per decade was about 0.20 to 0.23°C in the dry season and 0.13 to 0.16°C in the wet season (MRC 2010). Based on these estimates, it is projected that the mean temperature will have risen by 0.3 to 0.6°C by 2025, 0.7 to 2.7°C by 2060 and 1.4 to 4.3°C by 2090 (Figure 20). The expected warming will be more severe from December to June. Under the Intergovernmental Panel on Climate Change (IPCC) emission scenarios A1B, A2 and B1, it is expected that Cambodia's annual average rainfall will have increased by 31 percent by the 2090s (MRC 2010).

Figure 20: Mean Annual Temperature in Cambodia under A2, A1B and B1, 1960-2010



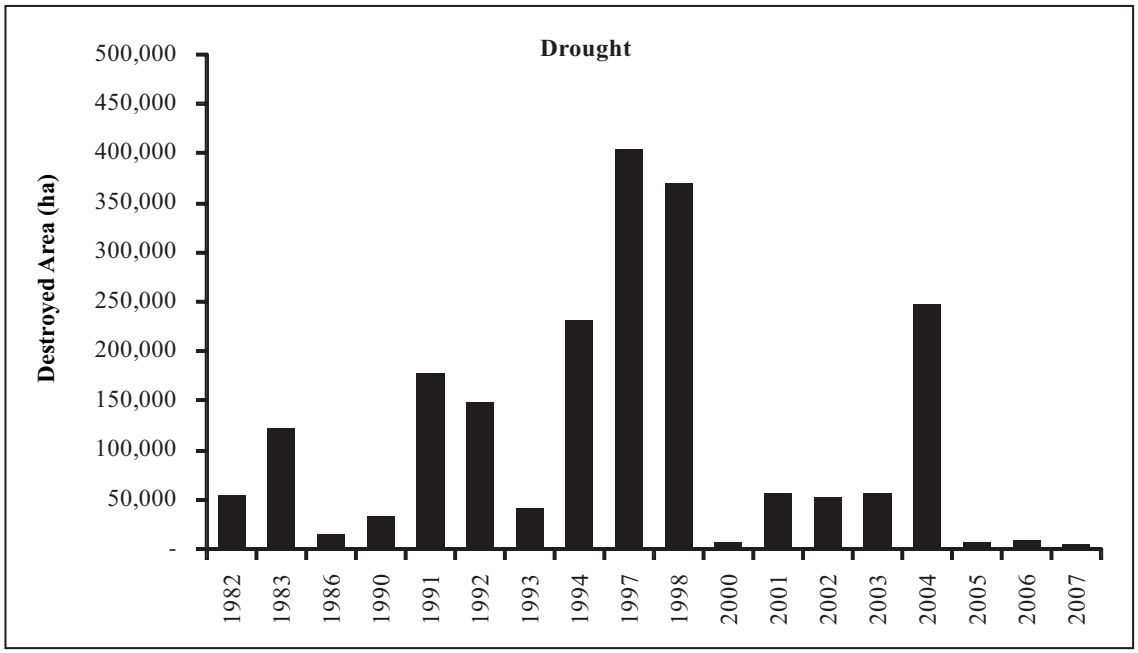
Source: MRC 2010

The temperature in some provinces has increased in the last few years and some crops have been affected. For example, in a discussion with local farmers on the past and present temperature, it was mentioned that:

> *We (farmers) faced drought in 2010. It was so hot and it impacted on all types of crops (rice, potatoes, cassava, banana and maize). It [drought] also happened in 2002-2003 and at that time there was no rain for the whole wet season. We lost the rice crop because there was no water (interview with farmers in Dang Kda village, Krayear commune, Santuk district, Kompong Thom province, May 2011).*

As illustrated in Figure 21, Cambodia's agriculture was seriously damaged by drought during 1991, 1992, 1994, 1997, 1998 and 2004. The 1997 socio-economic survey of the Ministry of Planning reports that about 36 percent of Cambodia's population was living below the poverty line (RGC 2002b). The World Bank reports that the overall poverty line for Cambodia in 2007 had decreased to 30.1 percent from 34.8 percent in 2004 (World Bank 2009: 27). This reflects the relationship between drought and poverty; in 2010 approximately 20,661 ha of crops were reportedly destroyed by drought, flood and insect infestation (MAFF 2011b: 18).

Figure 21: Total Crop Area Damaged by Drought, 1982-2007



Source: MAFF 2010b

Rice farming is significantly affected by drought, which mostly occurs in the middle of the wet season (known as the "small dry season"), and flood, especially at the end of the wet season (mid-October to mid-November). Such events happen almost every year in the major rice producing provinces of Prey Veng, Takeo, Kompong Cham, Kompong Thom, Battambang, Banteay Meanchey and Siem Reap provinces.

Successive droughts in 1997 and 1998 did not allow farmers to recover from the initial blow. As a result they suffered great hardship, went hungry, fell (deeper) into poverty, became sick or even died. Farmers said:

> *Temperature is hotter and has changed recently. There is a short cool wind but long [period of] hot air during the windy season between November and January. Drought in 2004/05 did incredible damage to the rice crop. We even lost our own seeds. Water shortage was a significant constraint to rice farming. There was no water in the canals; the scheme dried out because of the long drought. Normally the rainy season starts in mid-May, but that year it started in August. Last year, in 2010, the dry season was almost three months longer than usual (FGD with Kampang villagers, Svay Donkeo commune, Bakan district, Pursat province, 2011).*

Agriculture is the primary source of income for the poor rural population (RGC 2002b: 37). Food insecurity and under-nutrition, due mainly to low yields and the staple diet of rice and fish, is prevalent in all rural and some urban communities (TWGAW 2007: 21). A recent report from the Ministry of the Environment (MoE) reveals that the poorest groups of people are most vulnerable to the impacts of climate change (MoE 2011: 1). This underlines the imperative to scale-up efforts to increase farmers' adaptive capacity to climate change.

6.4. Legal Framework and Policy on Climate Change

Cambodia is a signatory of the UN Framework Convention on Climate Change (UNFCCC)[42]. The National Climate Change Committee, established in 2006, serves as a policy-making body and coordinates the development and implementation of policies to address climate change issues.

Recognising that climate change is a global issue and requires individual and collective effort to adapt or mitigate its impacts, Cambodia's government has developed comprehensive regulations and policies aimed at addressing climate change issues. The government's NAPA framework is to guide the coordination and implementation of adaptation initiatives through a participatory approach and build synergies with relevant environment and development programmes. This policy prioritises a number of main projects related to climate change adaptation with regards to human health, coastal ecosystems, water resources, fisheries and the agriculture sector. A set of national forestry regulations, policies and laws was developed to validate the overall development framework for the conservation and management of the country's forest resources. On 4 July 2002 Cambodia acceded to the Kyoto Protocol[43], which came into force on 22 August 2002. The MoE is the national focal point for the UNFCCC and the Kyoto Protocol[44]. The development of an effective and efficient mechanism and meteorological and hydrological networks for natural disaster prevention was prioritised in SEDP II (2001-05) (RGC 2002b:42). Meanwhile, with support from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the Korean International Cooperation Agency, the National Green Growth Roadmap was developed to conserve and restore the natural capital base for continued economic growth within the limits posed by the environmental carrying capacity (MoE 2009).

Resultant of efforts by government, local people and the authorities, the implementation of agricultural technologies and especially government policy to promote rice production and export, the production of rice and other main crops continues to improve. Meanwhile, recognising the importance of the water sector to agriculture sector development, the national policy on water resources in 2004 emphasises the development of water reservoirs to store water as well as catchment management to help prevent floods and mitigate the impacts of natural disaster (RGC 2004: 6). In the strategic development plans for agriculture and water resources implemented in 2007 (SAW), the government sets out its clear long term vision to ensure safe and accessible food and water for all Cambodians, reduce poverty, and contribute to economic growth, while ensuring the sustainability of natural resources (TWGAW 2007). The strategy also takes into consideration the conservation of critical ecosystems and biological diversity, the protection of irrigation, rivers and lakes from agro-chemical contamination, the protection of watersheds against degradation, and the appropriate action to be taken in response to climate change and variability (TWGAW: 12).

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42 A global mechanism that aims to provide an intergovernmental platform to mitigate the effects of climate change.

43 It is a legally binding agreement under which industrialised countries will reduce their collective emissions of greenhouse gases by 5.2 percent compared to 1990. The goal is to lower overall emissions from six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofleurocarbons (HFCs), and perfleurocarbons (PFCs) - calculated as an average over 2008-12. More information is available at: http://www.kyotoprotocol.com/

44 An international agreement linked to UNFCCC that sets binding targets for 37 industrialised countries and the European Community for reducing greenhouse gas emissions by an average of 5 percent against 1990 levels over 2008-2012.

Sustainable forest management and sustainable forest resource use is prioritised in the government's forest reform policy (RGC 2002c)[45]. Areas of denuded forest have been re-planted through tree planting programmes and other events where two to five million tree seedlings were provided to local people. Meanwhile, community forestry is being strengthened; the number of Forestry Communities had increased to 510 by the end of 2010, covering a total area of 467,884 ha (MAFF 2011a: 4). Sustainable forest management will ensure adequate forest resources for multiple benefits such as domestic consumption, fish sanctuaries, watershed protection, natural resources reserves, biodiversity and endangered species conservation and drought and flood prevention (TWGFE 2007: 2).

Cambodia has continued to develop and strengthen institutional capacity in both government agencies and community organisations to understand the impact of climate change on agriculture, forestry, fisheries, livestock, animal and human health, improved the country's capacity for long-term adaptation and resilience to climate change, and integrated these considerations into sectoral planning at all levels.

45 In its statement on National Forest Sector Policy, the government expressed its commitment to accomplishing the assigned tasks to achieve environmental protection, biodiversity conservation, poverty reduction, economic development and good governance.

7

Discussion and Conclusions

- Rice production and rice cultivated area have increased steadily over the last few decades. However, Cambodia's rice yield is still the lowest in the region when compared to neighbouring countries. Increased production is largely due to expansion of the cultivated area rather than intensive efforts to improve productivity. Limited agricultural technology, poor inputs application (seed variety, fertiliser, pesticide) and limited access to irrigation water are the major constraints to increasing productivity. It is widely acknowledged that better agricultural technology and irrigation infrastructure are essential not only for increased productivity but also to help mitigate increasingly unreliable rainfall distribution. However, local rice markets are underestimated in terms of cost recovery. In addition, the frequency of natural shocks i.e., drought, flood and cyclone, pose additional risk to the low productivity of the existing agricultural rice system. This could push the majority of Cambodian farmers into a critical situation and erode efforts to alleviate poverty and ensure national food security.

- Agro-industrial crop production, particularly rubber, is expected to increase over the next few years. The fluctuating market price of cassava showed signs of recovery in the first half of 2011, leading to increased land use change as the area of cassava plantation expanded. However, the amount of cassava cultivated is dependent on market demand. Expansion of agricultural land through the granting of ELCs has diminished forest cover, including in protected areas. This will impact directly and indirectly in both the short and long term unless the requisite socio-economic impact assessments to assure sustainable development are properly implemented.

- Fisheries, both marine and freshwater, are vitally important to livelihoods and agricultural sector growth. However, the combined effects of over-fishing, climate change (precipitation) and hydrological change, including the depletion of nutrients in the Mekong River and the Tonle Sap Lake, will likely lead to declined fisheries stock and species extinction. This situation needs to be urgently addressed in order to secure the future sustainability of fisheries resources. That coastal and marine fishery stocks are being exploited beyond their regenerative capacity is another emerging concern. It is imperative to assess and monitor available fish stock and current fishing quotas. Employing modern offshore fishing technology may help ease the current pressure on inshore fisheries.

- Forest resources are important for local livelihoods and the environment even though they no longer provide as many benefits as they used to. It might take a long time for depleted forests to recover, but remaining forest resources are still important for forest dwellers' subsistence. Inappropriate land use will not only exacerbate depletion of forest resources but will also adversely impact on the environment and local livelihoods, particularly indigenous people.

- Natural shocks such as flood, drought and cyclone occur more frequently and can have devastating consequences for agriculture, particularly rice farming. These events tend to hit the most vulnerable rural poor the hardest. Farmers should be encouraged to adapt their farming to better cope with the impacts of natural phenomena. Irregular rainfall is a significant constraint to improving rice productivity; supplementary water from irrigation schemes is essential to overcoming this obstacle.

In a general sense, every effort towards increasing agricultural production is significantly important for poverty alleviation and food security. However, development efforts must integrate environmentally sound practice in maximising productivity through intensifying farming rather than by extending the cultivated area. In addition, appropriate measures to ensure sustainable natural resource management need to be taken. Fluctuating market prices push farmers to shift their cultivation. Irregular rainfall and associated shocks are increasingly damaging to agriculture, assets and human life. Unreliable rainfall also impacts on cultivation calendar/season of rice farming as majority of farmers in most rain-fed areas grow only one crop a year. The combination of low rice productivity and price fluctuations may be a critical constraint to improving farmers' livelihoods. It is also expected that the development of more physical irrigation infrastructure will create more opportunities for intensive farming, for instance double or triple rice-cropping.

Climate change is both a regional and global ecological phenomenon. Its effects are tangible and already being felt in Cambodia (MoE & UNDP 2010). Cambodians are aware that the country's climate is changing. Flood, drought and higher temperatures are the extreme weather conditions recognised by most farmers as the factors that could harm their daily activities and livelihoods.

Compared to neighbouring countries like Vietnam and Thailand, Cambodia's crop productivity rates, mainly rice, are low. Poverty incidence, rural roads, irrigation and market infrastructure are limiting factors (Hegadorn 2011). It is difficult to pinpoint the specific relationship between the decline in natural resources to make way for agricultural expansion and development and the effects of climate change on Cambodia's agricultural sector. However, since the majority of people live in rural areas and rely on this sector for their livelihoods, the effects of climate change would likely have serious consequences. Climate change is a cross-cutting issue in various national development activities. Climate change adaptation and resilience could be mainstreamed and implemented at provincial, district and commune levels. Meanwhile, as many rural poor are already living below the poverty line, suitable climate adaptation measures to help them cope with extreme weather constraints must be put in place.

8

Recommendations

- Proper land-use/cover management and conservation should be taken into account to ensure that agriculture sector development is environmentally friendly, conserves forest ecosystem services, and supports the value chain of the whole agriculture system in that region.
- Mechanisms to regularly monitor, evaluate and control agro-industrial development so as to maximise adaptation to climate change should be devised and implemented by government institutions and local authorities.
- Education and training on system of rice intensification and pest management should be extended to farmers so as to increase and diversify agricultural productivity and minimise harm to human health and ecosystems.
- Farmers' capacity should be improved; all agriculture related agencies should encourage farmers to participate in community-based natural resources management or farmer water user communities. Appropriate technology i.e. mechanisation, new seed varieties, and necessary inputs to diversify crop farming and increase crop productivity should be available to farmers.
- Measures to ensure effective and efficient implementation of initiatives so as to meet the aims of national policies, particularly forest management policy and long term adaptation strategy for agricultural development, should be put in place.
- Water resources and irrigation services must be mainstreamed in the integrated strategic development programme to mitigate environmental impacts of climate change, consistent with government's prioritisation of water sector policy as one of the top four strategies towards national development efforts.
- Physical irrigation infrastructure development is urgently needed to cope with uncertainties due to climate change (irregular rainfall and water levels) and the growing frequency of natural calamities (drought, flood, cyclone) and to extend the cultivation area so as to intensify agricultural production and ensure national food security.

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Appendices

Table A1: Population Density by Region, 1981-2008

Province	Area	Population in '000'					Density (person/sq.km)				
		1981	1994	1998	2004	2008	1981	1994	1998	2004	2008
Plain	25069	3613	5202	5898	6310	6546	144	208	235	252	261
Phnom Penh	290	329	812	1000	1044	1326	1134	2800	3448	3600	4571
Kandal	3568	720	855	1075	1203	1265	202	240	301	337	355
Kompong Cham	9799	1070	1464	1609	1656	1681	109	149	164	169	172
Svay Rieng	2966	292	443	478	514	483	98	149	161	173	163
Prey Veng	4883	672	933	946	1013	947	138	191	194	207	194
Takeo	3563	530	695	790	880	844	149	195	222	247	237
Tonle Sap	67668	1971	2935	3505	4172	4354	29	43	52	62	64
Banteay Meanchey	6679	-	489	578	679	678	-	73	87	102	102
Battambang	11702	719	648	793	972	1025	61	55	68	83	88
Kompong Chhnang	5521	221	326	418	532	472	40	59	76	96	85
Kompong Thom	13814	379	490	569	607	631	27	35	41	44	46
Siem Reap	10299	477	680	696	755	896	46	66	68	73	87
Oddar Meanchey	6158	-	-	68	130	185	-	-	11	21	30
Pailin	803	-	-	22	41	70	-	-	27	51	88
Pursat	12692	175	302	360	456	397	14	24	28	36	31
Coastal	20237	432	673	845	959	960	21	33	42	47	47
Kampot	7873	354	481	528	596	585	45	61	67	76	74
Koh Kong	11160	25	71	132	118	140	2	6	12	11	13
Kep	336	-	-	29	58	36	-	-	85	173	106
Sihanoukville	868	53	121	156	187	200	61	139	179	215	230
Plateau /mountainous	68061	666	942	1189	1383	1528	10	14	17	20	22
Kompong Speu	7017	340	490	599	677	717	48	70	85	96	102
Kratie	11094	157	212	263	329	319	14	19	24	30	29
Mondulkiri	14288	16	22	32	150	61	1	2	2	10	4
Preah Vihear	13788	69	98	119	100	171	5	7	9	7	12
Ratanakiri	10782	45	64	94	37	150	4	6	9	3	14
Stung Treng	11092	39	56	81	90	112	4	5	7	8	10

Source: NIS 2008

Table A2: Literacy Rate by Age-group and Sex, 2004 and 2007

Age	2004				2007			
	Males		Females		Males		Females	
	Number	%	Number	%	Number	%	Number	%
7-10	318844	(41.1)	299016	(41.7)	254344	(40.3)	265369	(44.4)
11-20	1443277	(82.1)	1376702	(80.5)	1440432	(89.2)	1430654	(87.8)
21-30	830128	(79.7)	722273	(65.4)	987152	(83.8)	861276	(72.4)
31-40	621970	(79.5)	519109	(60.7)	629046	(83.2)	552585	(66.3)
41-50	395127	(77.6)	356287	(53.6)	481127	(80.6)	403335	(59.0)
51-60	244146	(82.0)	191476	(45.1)	327301	(87.8)	274338	(51.5)
61-70	123013	(72.3)	46943	(20.3)	153412	(86.2)	92161	(32.1)
71-80	49528	(56.5)	1019	(8.6)	68104	(66.0)	16673	(12.3)
81 +	9486	(47.6)	1965	(3.0)	12444	(41.0)	6681	(17.5)

Source: NIS 2008

Table A3: Number of Persons aged10 and over in the Labour Force, Employment and Unemployment by Educational Attainment 1998 and 2001

Educational Attainment	1998						2001					
	Labour Force		Employment		Unemployment		Labour Force		Employment		Unemployment	
	n	%	n	%	n	%	n	%	n	%	n	%
Both sexes	325221	(100.0)	318300	(100.0)	6921	(100.0)	6359170	(100.0)	6243329	(100.0)	115841	(100.0)
No attended school	27708	(8.5)	27465	(8.6)	243	(3.5)	943244	(14.8)	931862	(14.9)	11382	(9.8)
No class completed	7538	(2.3)	7538	(2.4)	0	(0.0)	239203	(3.8)	238293	(3.8)	910	(0.8)
Class 1	3131	(1.0)	3131	(1.0)	0	(0.0)	208931	(3.3)	205986	(3.3)	2945	(2.5)
Class 2	9303	(2.9)	9303	(2.9)	0	(0.0)	592429	(9.3)	578291	(9.3)	14138	(12.2)
Class 3	26512	(8.2)	25779	(8.1)	733	(10.6)	831528	(13.1)	820999	(13.2)	10529	(9.1)
Class 4	25700	(7.9)	24943	(7.8)	757	(10.9)	778518	(12.2)	755756	(12.1)	22762	(19.6)
Class 5	36597	(11.3)	36349	(11.4)	248	(3.6)	714989	(11.2)	704582	(11.3)	10407	(9.0)
Class 6	20814	(6.4)	20261	(6.4)	553	(8.0)	467285	(7.3)	457899	(7.3)	9386	(8.1)
Class 7	30042	(9.2)	29061	(9.1)	981	(14.2)	491158	(7.7)	483001	(7.7)	81587	(7.0)
Class 8	37237	(11.4)	36504	(11.5)	733	(10.6)	389379	(6.1)	380347	(6.1)	9032	(7.8)
Class 9	26040	(8.0)	24394	(7.7)	1646	(23.8)	292571	(4.6)	287591	(4.6)	4980	(4.3)
Class 10	14515	(4.5)	14247	(4.5)	268	(3.9)	101551	(1.6)	97634	(1.6)	3917	(3.4)
Class 11	11426	(3.5)	11163	(3.5)	263	(3.8)	72804	(1.1)	69739	(1.1)	3065	(2.6)
Secondary school certificate/diploma	25667	(7.9)	25171	(7.9)	496	(7.2)	120162	(1.9)	117766	(1.9)	2396	(2.1)
Vocational/BST/OS undergraduate	4390	(1.3)	4390	(1.4)	-		39449	(0.6)	38667	(0.6)	782	(0.7)
Vocational/BST/OS graduate	7464	(2.3)	7464	(2.3)	-		1676	(0.0)	1549	(0.0)	127	(0.1)
Undergraduate	1362	(0.4)	1362	(0.4)	-		26540	(0.4)	26540	(0.4)	-	
Graduate/Degree holder	7897	(2.4)	7897	(2.5)	-		6830	(0.1)	6699	(0.1)	131	(0.1)
Post graduate	741	(0.2)	741	(0.2)	-		19636	(0.3)	18840	(0.3)	796	(0.7)
Not reported/unknown	1137	(0.3)	1137	(0.4)	-		21287	(0.3)	21287	(0.3)	-	

Source: NIS 2008

Table A4: Number of Persons Aged 10 and over in Labour Force, Employment and Unemployment by Educational Attainment 2004 and 2007

Educational Attainment	2004						2007					
	Labour force		Employment		Unemployment		Labour force		Unemployment		Unemployment	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Both sexes	7563862	(100.0)	7501383	(100)	62479	(100.0)	7844113	(100.0)	7792468	(100.0)	51645	(100.0)
Pre-school/Kindergarten	30845	(0.4)	30845	(0.4)	-		20841	(0.3)	20841	(0.3)	-	
None or some education	1707431	(22.6)	1697061	(22.6)	10370	(16.6)	1400220	(17.9)	1394707	(17.9)	5512	(10.7)
Class 1 completed	239568	(3.2)	238282	(3.2)	1286	(2.1)	189073	(2.4)	189073	(2.4)	-	
Class 2 completed	511734	(6.8)	510316	(6.8)	1417	(2.3)	477090	(6.1)	472819	(6.1)	4271	(8.3)
Class 3 completed	799285	(10.6)	794880	(10.6)	4404	(7.0)	830151	(10.6)	824680	(10.6)	5471	(10.6)
Class 4 completed	878524	(11.6)	874554	(11.7)	3971	(6.4)	906598	(11.6)	899051	(11.5)	7546	(14.6)
Class 5 completed	766602	(10.1)	759135	(10.1)	7466	(12.0)	838336	(10.7)	834221	(10.7)	4115	(8.0)
Class 6 completed	611964	(8.1)	607669	(8.1)	4295	(6.9)	741326	(9.5)	736663	(9.5)	4663	(9.0)
Class 7 completed	597191	(7.9)	590782	(7.9)	6409	(10.3)	660880	(8.4)	660119	(8.5)	761	(1.5)
Class 8 completed	440099	(5.8)	435294	(5.8)	4805	(7.7)	505125	(6.4)	502273	(6.4)	2852	(5.5)
Class 9 completed	357055	(4.7)	352896	(4.7)	4159	(6.7)	412280	(5.3)	409264	(5.3)	3016	(5.8)
Class 10 completed	143765	(1.9)	141840	(1.9)	1925	(3.1)	169583	(2.2)	168154	(2.2)	1430	(2.8)
Class 11 completed	92563	(1.2)	90468	(1.2)	2095	(3.4)	130572	(1.7)	128459	(1.6)	2113	(4.1)
Class 12 completed	141968	(1.9)	138952	(1.9)	3015	(4.8)	188688	(2.4)	186611	(2.4)	2077	(4.0)
Secondary school certificate	90298	(1.2)	86787	(1.2)	3512	(5.6)	88822	(1.1)	88822	(1.1)	-	
Technical/vocational pre-secondary/diploma/certificate	28011	(0.4)	27791	(0.4)	219	(0.4)	43412	(0.6)	42820	(0.5)	592	(1.1)
Technical/vocational post-secondary/ diploma/ certificate	22898	(0.3)	21653	(0.3)	1245	(2.0)	12955	(0.2)	11971	(0.2)	984	(1.9)
College/university undergraduate	7319	(0.1)	6934	(0.1)	385	(0.6)	27962	(0.4)	23206	(0.3)	4756	(9.2)
Bachelor degree (B.A, BSc)	40776	(0.5)	39712	(0.5)	1064	(1.7)	82046	(1.0)	80563	(1.0)	1484	(2.9)
Master degree (MA, MSc)	3472	(0.0)	3472	(0.0)	-		16490	(0.2)	16490	(0.2)	-	
Doctorate degree (PhD)	-		-		-		3990	(0.1)	3990	(0.1)	-	
Other	19125	(0.3)	18690	(0.2)	345	(0.7)	733	(0.0)	733	(0.0)	-	
Don't know	33370	(0.4)	33370	(0.4)	-		23911	(0.3)	23911	(0.3)	-	

Source: NIS 2008

Table A5: Imported Agricultural Inputs and Animal Medicines (2003-2007)

Year	Fertilizers (t)	Items	Pesticides (t)	Items	Animal feeds (t)	items	Seeds (t)	items	Animal medicines (t)	items
2003	43620	47	47.5	28	0	0	283	20	0	0
2004	157821.12	43	30.002	161	27000	12	1000.072	10	0	0
2005	285100	35	172	136	75500	6	328.018	N/A	0.005	N/A
2006a*	118249.23	30	542.059	30	24232	30	1129.098	N/A	108.22	18
2007b*	168530	39	173.7	31	81648	31	1226.971	N/A	N/A	57

Source: MAFF 2008

Notes: - 2006a*: 27 companies were permitted to import agricultural inputs; 33 items of fertiliser and manure (123,258.445 tonnes) and chemicals (532.880 tonnes). Inventory in late 2006 noted that the fertilisers remaining 3,889.174tonnes.

- 2007b*: Statistics on agricultural inputs imports from 2007 to January 2008 noted that chemical and natural fertilisers (189,536.100 tonnes) and chemicals (167.70 tonnes).

Table A6: General Information on Fishing Efforts in Cambodia

Category	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hatchery station	-	-	-	-	-	-	-	-	-	15	-	16	16	21	22
Aquaculture (tonnes)	8779	9000	11534	13903	14938	14410	13857	14547	18410	20,030	25,890	33625	33390	37815	47120
Crocodile (heads)	14691	20200	17000	40700	25380	26300	36000	50850	78008	150372	120000	137642	128945	156500	185000
Fingerling (000 heads)	5096	5100	4124	5060	9260	7508	11000	13293	14293	15793	18733	21335	33708	37193	69750
Coastal aquaculture (tonnes)	-	-	-	-	-	-	-	-	-	805	-	575	1870	2185	2800
Shrimp culture	731	600	266	197	62	20	143	53	90	75	110	40	70	75	80
Seaweed (tons)	-	-	-	-	-	-	3500	3650	7800	16840	18000	6810	-	-	-
Boat with no engine (coast)	733	3512	601	518	430	1280	1535	1283	1683	1195	1765	1059	984	1297	1297
Motorised boats (coast)	1406	1602	3561	3732	3785	2177	5000	5606	6098	7093	7350	6236	7096	7365	7335
Boat with no engine (inland)	-	-	-	-	-	-	-	-	-	39452	-	58490	55980	56778	60421
Motorised boats (inland)	-	-	-	-	-	-	-	-	-	21435	-	32017	31636	37055	39092
Family involved in fishing (sea)	3009	4910	3532	3221	3910	6787	5717	20096	14790	24224	18073	32306	35092	31814	44014
Family involved in inland fishing	-	-	-	-	-	-	-	-	-	255441	-	213073	269335	335775	406678

Source: FA 2009

Table A7: Statistics of Economic Land Concessions

No	Area(ha)	Location (province)	Purpose of investment	Contract (year)
1	13200	Battambang	Sugarcane, cassava and rubber	70
2	14070	Kompong Cham	Cashew-apple, rubber, cassava, sugarcane and other crops and animal husbandry	70
3	315028	Kompong Chhnang. Pursat	Tree plantations and paper factory	70
4	48081	Kompong Speu	Cassava, oil-palm, jatropha and other tree plantations or agro-industrial crops, Pepper factory and animal husbandry	70
5	48161	Kompong Thom	Agro-industrial crops, acacia, rubber, cassava, animal husbandry and processing factories	70
6	35800	Kampot	Oil-palm, maize, other agro-industrial crops, animal husbandry and processing factories	
	102591	Kratie	Rubber, cassava, sugarcane, cashew and other tree plantation and processing factories	70
7	79300	Koh Kong	Oil-palm, fruit-trees and sugarcane and acacia	70
8	57345	Mondulkiri	Pine (Merkusii), rubber, acacia and factories	70
9	6060	Preah Vihear	Rubber plantation	70
10	3000	Pursat	Cashew-apple and oil palm	70
11	61959	Ratanakiri	Animal husbandry, processing factories, agro-industrial crops (oil-palm, coffee plantation,. etc)	70
12	9577	Siem Reap	Rubber and other agro-industrial crops	70
13	9658	Siem Reap and Uddor Meanchey	Rubber and other tree plantations	70
14	12800	Sihanoukville	Oil-palm and cassava and factories	70
15	193263	Stung Treng	Animal husbandry, processing factories, agro-industrial crops, rubber, cassava plantation, etc.	70
16	27736	Uddor Meanchey	Cassava, sugarcane and processing factories	70

Source: MAFF 2010c (ELC profile- www.elc.maff.gov.kh)

Table A8: List of Relevant Agencies in Agricultural Development

No.	Name and contact address	Kind of business
Organization International (OI) and Non-governmental Organization (NGO)		
1	GERES Cambodia. Fax: (855-23) 221 314 This e-mail address is being protected from spambots. You need JavaScript enabled to view it This e-mail address is being protected from spambots. You need JavaScript enabled to view it http://www.geres-cambodia.org	Agricultural extension
2	LI – The Learning Institute Tel: (855-23)994 935 Fax: (855-23)224 171 www.learninginstitute.org	Community-based natural resource management (CBNRM)
3	CEPA – Culture & Environment Preservation Association Tel & Fax: 023 369 179	Advocacy
4	ATSA – Agriculture Technology Service Association Tel: (855-23) 222 684 Fax: (855-23) 222 684 www.atsacambodia.org	Pest management, agricultural inputs
5	Mlup Baitong (Green shadow) Tel: (855-23) 214-409/ Fax: (855-23) 220-242	Community-based natural resource management (CBNRM)

No.	Name and contact address	Kind of business
6	SCW – Save Cambodia's Wildlife Fax: (855-23) 222 036 info@cambodiaswildlife.org	Community-based natural resource management (CBNRM)
7	CFI – Community Forestry International Tel: (855-23) 220 714 www.comunityforestryinternational.org/cambodia	Community based natural resource management
8	WCS – Wildlife Conservation Society info@wcscambodia.org	Protecting natural resources
9	CCC – Cooperation Committee for Cambodia Fax: (855-23) 216 009. www.ccc-cambodia.org	Advocacy, natural resource management and livelihoods
10	FFI – Fauna and Flora International Tel: (855-23) 220 534, www.fauna-flora.org	Natural resource protection, forestry community and livelihoods
11	CAVAC – Cambodia Agriculture Value Chain Program Tel & Fax: (855-23) 215 819	Agro-business and marketing
12	FLD – Farmer Livelihood Development Tel: (855-23)998 442/ www.fldcambodia.org	Farmer's livelihood
13	Organization for Agriculture Development of Cambodia H/P: (855-23) 012 644 567	Agricultural development
14	PADEK – Partnership for Development in Kampuchea www.padek.org P.O Box 554 Phnom Penh	Agriculture, aquaculture and rice farming
15	Srer Khmer Organization Tel: (855-23) 210 217	Rice farming and other crops
16	ADI – Agriculture Development International, Tel: (855-23) 997 804	Agriculture
17	Fisheries Action Coalition Team , Tel &Fax: (855-23) 992 044	Advocacy and fisheries management
18	GRET – Group de Recherche et d'Echanges Technologiques Tel: (855-23) 220 259	Agricultural extension
Private companies and associations		
1	CEDAC – Centre d'Etude et de Development Agricole Cambodgien. Tel: (855-23)880 916/ Fax: (855-23)885 146 Email: cedacinfo@cedac.org.kh	Agricultural extension, especially rice seed varieties
2	LORAN Import-Export Co., Ltd. Tel: (855-23)432 168/ Fax: (855-23) 430 777 http://www.loranrice.com	Rice mill, rice export
3	Mettapheap Men Sarun Agirculture Development Co., Ltd. Fax 023 213 305/ www.mensarun.com.kh	Agricultural investment and exportation
4	BVB Machinery Trading Co., Ltd. Tel: (855-23) 6363 288/	Agricultural machinery supplier
5	CAPESCO – Cambodia Pesticide Company., Ltd Tel: (855-23)300 489/6777 489/ Fax: 855-23 350 489 www.capesco-cambodia.com	Pesticide supplier
6	Agriculture Development Co., Ltd Tel & Fax: (855-23) 427 572	Tractors and other machinery supplier
7	Agrotech Co., Ltd. Tel: (855-23) 726 016/ Fax: (855-23) 726 016	Insecticide, herbicide, fungicide and fertilizer supplier
8	Nokorthom Agriculture Development Co., Ltd. Tel & Fax: (855-23) 993 975Email: nokorthom.agri@gmail.com	Plant protection, plant disease and treatment
9	Paragon Corporation Tel: (855-23) 210 999 www.paragon-corp.com	Rice and cashew farming, processing, export, farm land for lease and sales
10	AGROKHMER H/P: 012 582 505/ 016 848 841 info@agrokhmer.com or www.agrokhmer.com	Seeds: flower, vegetable & fruit, insecticide, pesticide, fertilizer (chemical & organic) & tools
11	Agriculture Input Company, Tel: (855-23) 213 789	Agricultural equipments and supplies

No.	Name and contact address	Kind of business
12	Baitang (Kampuchea) Plc, Tel & Fax: 023 950 210	Agricultural seedling and spraying
13	General Development Group Co., Ltd. Tel: (855-23) 996 206	Agricultural seedling and spraying
14	Grandis Timber Limited, Tel & Fax: (855-23) 882 173	Agricultural seedling and spraying
15	Green Garden Tel: (855-23) 077 839 394	Agricultural seedling and spraying
16	HLH Agriculture Cambodia Co., Ltd. Tel: (855-23) 995 050	Agricultural seedling and spraying
17	IDE – International Development Enterprises Tel: (855-23) 223 541/ Fax: (855-23) 223 540 www.ide-cambodia.org P.O Box 1577	Hydrologic Social Enterprise, Farm Business Advisor, Drip irrigation, Fertilizer, Agribusiness Development
18	IsoTerra Tel: (855-23) (012) 804 580/826 112 isoterra.cambodia@gmail.com or www.isoterra.net	Recycling management, organic fertilizers & compost producer
19	Association for Rubber Development of Cambodia Tel: (855-23) 725 571	Association, Rubber plantation and business
20	CADA – Cambodia Agriculture Development Association Tel: (855-23) (089) 759 599	Association, agricultural farming
21	Cambodia Agriculture & Jatropha Association H/P: (855-23) (012) 868 998	Association in Jatropha plantation and business
22	Cambodian Golden Rice Association H/P: (855-23) (012) 790 168	Associations, rice export and agricultural development
23	COrAA – Cambodia Organic Agriculture Association H/P: 092 847 830	Association, organic agriculture
24	Dragon Soar International Group Co. Tel: (855-23) 991 386	Rice seed supplies
25	Angkor Kasekam Roongroeung Co., Ltd. Tel: (85523)364 005	Rice wholesalers
26	Battambang Rice Distribution Depot. H/P: 012 971 756	Rice wholesalers
27	Battambang Rice Shop, H/P: (855-23) (012) 823 291	Rice wholesalers
28	Bayon Rice Store, H/P: (855-23) (016) 888 455	Rice wholesalers
29	Cambodia Rice Enterprise, H/P: 017 711 066	Rice wholesalers
30	Eak Heng Rice Shop, Tel: (855-23) 214 705	Rice wholesalers
31	HCLP Co., Ltd, Tel (855-23) 6382 030	Rice wholesalers
32	JC Holding Co., Ltd, Tel: (855-23) 214 481	Rice wholesalers
33	Chan Ratanak Rice Shop H/P: (855-23) (011) 923 163	Rice Miller Services
34	Khmer Food Co., Ltd. H/P: 012 882 222, 15 882 222, Fax: (855-23) 720 464 www.khmerfood.com.kh	Rice exporters, and labelling
35	Kim Savuth Rice Wholesaler Shop, Tel: (855-23) 993 132	Rice wholesalers
36	Koh Pich Rice Shop, H/P: 012 489 486	Rice wholesalers
37	Lay Min Rice Shop, H/P: 012 889 474	Rice wholesalers
38	Ly Song Seng, H/P: 012 735 376	Rice wholesalers
39	Men Sarun Import Export & Construction Co., Ltd. Tel: (855-23) 218 505, Fax 023 213 305 www.mensarun.com.kh	Rice wholesalers
40	Ngoun Mony Rice Shop, H/P: 011 959 054	Rice wholesalers
41	Oeum Investment Group Co., Ltd., H/P: 012 260 005	Rice wholesalers
42	Phou Guech Chou, H/P: 012 774 787	Rice wholesalers
43	Rice Producer (Cambodia), H/P: 012 987 979	Rice wholesalers
44	SCL – Sahakreas Cedac Ltd., H/P: 089 333 569	Rice wholesalers
45	Song Heng Rice Store, H/P: 012 511 356	Rice wholesalers
46	Sous On, H/P: 011 200 208	Rice wholesalers
47	Sovannaphumi Khmer's Rice, H/P: 012 418 741	Rice wholesalers
48	Taing Cheng Rice Shop, H/P: 011 681 602	Rice wholesalers

No.	Name and contact address	Kind of business
49	White Gold, Tel: (855-23) 6363 791	Rice wholesalers
50	DTC Group Co., Ltd., H/P: 011 208 296	Rubber Plantations
51	Reththy Kiri Seyma Co., Ltd. Tel: (855-23) 211 065	Rubber Plantations
52	Rubber Small Holder Development Project, Tel: (855-23) 430 875	Rubber plantations
53	Socfin KCD, Tel: (855-23) 881 779	Rubber plantations
54	Tai Seng Rubber Enterprise Trading Co., Ltd. Tel: (855-23) 723 492	Rubber plantations
55	TTY Corporation Co., Ltd. Tel: (855-23) 220 942	Rubber plantations
56	VRG – Vietnam Rubber Group, H/P: 011 970 503	Rubber plantations
Public sector		
1	MAFF – Ministry of Agriculture Forestry and Fishery #200 Norodom Boulvard Phnom Penh Cambodia Fax: (855-23) 217320 http://www.maff.gov.kh	Agricultural extension, issue certificate to private firms in dealing with agriculture in general
2	FA – Forestry Administration Fax/Phone : 855 23 212 201 or Email: kamfo@online.com.kh	Forest management
3	FiA – Fishery Administration Tel: (855-23) 215 796/ Fax: (855-23) 215 470	Fisheries management, both inland and coastal/marine
4	MoE – Ministry of Environment Fax: (855-23) 427844 http://www.camnet.com.kh/moe	Protected areas including sustainable development
5	CDC – Council for the Development of Cambodia Tel: (855-23) 981 154/ Fax (855-23) 428 426	Legal procedures on investments in Cambodia
6	Department of Agriculture Machinery Tel: (855-23) 885 352	Technical and machinery technology
7	Department of Agriculture Engineering Tel & Fax: (855-23) 883 090	Agricultural engineering
8	General Directorate of Rubber Plantations Tel: (855-23) 722 590	Rubber management and research
9	Royal University of Agriculture, Tel: (855-23) 219 829	Universities & Colleges (Academic)
10	Royal University of Phnom Penh Tel: (855-23) 883 640	Universities & Colleges (Academic)

Source: GREEN BOOK 2009 www.greenbook.cbnrmli.org

Table A9: List of Microfinance Institutions and Commercial Banks in Cambodia

No	Name	Address	Remarks
1	ABA Bank	Nº 148, Sihanouk (St. 274), Tel: (855) 23 225 333 Fax: (855) 23 216 333 E-mail: info@ababank.com Website: www.ababank.com	Phnom Penh Head Office and six Branches in the city. Two provincial branch offices
2	ACLEDA Bank Plc.	Nº61, Preah Monivong, Srah Chork, Khan Daun Penh, Tel: (855) 23 430 999/998 777 Fax: (855) 23 430 555/998 666 E-Mail: acledabank@acledabank.com.kh Website: www.acledabank.com.kh	Phnom Penh Headquarters. Several branches in the city and 270 provincial and district branches
3	Amret	#35BA, Street (169), Veal Vong, 7 Makara, Phnom Penh, P.O. Box 411 Tel: (855) 23 999 033/880 942 Fax: (855) 23 881 342 E-mail: info@amret.com.kh Website: www.amret.com.kh	Several Branches in the city and several Branches in the Provincial and District Offices

No	Name	Address	Remarks
4	CREDIT Microfinance Institution	Building Nº71, St. 163, Toul Svay Prey I, Chamkar Morn, Phnom Penh, Tel: (855) 23 217 942 / Fax: (855) 23 217 942 E-mail: info@credit.com.kh Website: www.credit.com.kh	Phnom Penh Head Office, pluses few branches in the city. Several Branches at the Provinces and Districts
5	PRASAC MFI	Nº25, St 294 & 57, Boeung Keng Kang 1, Chamkarmon, Phnom Penh Tel: (855) 23 220 102 / Fax: (855) 23 216 362 Website: www.prasac.com.kh	Few Branches in the city Several Branches at the Provinces and Districts
6	SATHAPANA LIMITED	Nº831C, Monivong Blvd., Phsa Dem Thkov, Chamkarmon, Phnom Penh Tel: 023 996 201 Website: www.sathapana.com	Few Branches in the City Several Branches at the provinces
7	Thaneakea Phum (CAMBODIA), Ltd.	Nº94, Street 360, Boeung Keng Kang III, Chamkar Morn, Phnom Penh Tel: (855) 23 220 641 Fax: (855) 23 220 642, Website: www.tpc.com.kh	Phnom Penh Head Several Branches at the Provinces
8	Cambodia Asia Bank (CAB BANK)	Nº439, Monivong Blvd., Phnom Penh, Cambodia Tel: (855) 23 220 000 / Fax: (855) 23 426 628 Website: www.cab.com.kh	Phnom Penh Head Several Branches at the Provinces
9	CANADIA BANK PLC.	Nº315, Ang Duong, Monivong Blvd., Cambodia Tel: (855-23) 868 222 Fax: (855-23) 427 064 www.canadiabank.com.kh	Phnom Penh Head 28 Branches at the Provinces
10	SBC Bank	Nº68, Samdech Pan St. (St. 214), Phnom Penh Tel: (855) 23 21 12 11 Fax: (855) 23 21 21 21. Telex: (51) 9407 1065 BANK G	Head Office and 3 Branches in the city 5 Branches
11	AMK – Angkor Microfinance (Kampuchea)	Nº442, Street 193, 12308 Tel: 023 993 062	Phnom Penh Main Several branches at the Provinces
12	ANZ Royal Bank (Cambodia) Ltd.	Nº20, Kramuon Sar (St. 114), corner of Street 67 Tel: (855) 23 999 000 Fax: (855) 23 221 310 www.anzroyal.com	Phnom Penh Head Several branches at the Provinces
13	CMSC Network (Cambodia Mutual Saving & Credit Network)	Nº81, Poland Republic Blvd (St. 163), Tel: 023 221 971 Fax: 023 990 521 Website: www.cmscnetwork.com	Phnom Penh Head 10 Branches at the Provinces
14	HATTHA KAKSEKAR LIMITED	Nº239, Trasak Paem (St. 63), Boeung Keng Kang I, Tel: 023 994 304 / 023 224 102 Fax: 023 996 306 www.hkl.com.kh	Head Office Several branches in the provinces
15	VisionFund (Cambodia) Ltd	Nº20, Street 71, Sangkat Tonle Bassac, Khan Chamkar Morn Tel: 023 216 052 Ext. 012 Fax: 03 216 220, www.visionfund.com.kh	Phnom Penh Main Office Several branches at the Provinces

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