Agriculture, irrigation and poverty reduction in Cambodia: Policy narratives and ground realities compared

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AGRICULTURE, IRRIGATION AND POVERTY REDUCTION IN CAMBODIA: POLICY NARRATIVES AND GROUND REALITIES COMPARED

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BACKGROUND

This report is a contribution to an assessment of the current status of agriculture in Cambodia, focusing on the linkages between agriculture and water, mainly in the form of irrigation. It seeks to view current government policies on agriculture and irrigation in the context of experiences on the ground, as communicated through the many field studies that cover varied aspects of performance in the agriculture sector and irrigation schemes. In an effort to identify future research areas, this review examines the status quo, and connects or disconnects with stated policy through a broad lens to capture strengths and challenges across crop production, irrigation management and post-harvest contexts. It places irrigation under scrutiny in terms of its value as a major area of government expenditure in recent years, and asks whether it presents the best potential for future gains in productivity, when compared with the prospects offered by investments in other aspects of agriculture.

The fieldwork and review of current literature that form the basis of this report were undertaken at the request of, and partly funded by, the Australian Centre for International Agricultural Research (ACIAR). It is also intended to contribute knowledge to the CGIAR Research Program on Aquatic Agricultural Systems (AAS) led by WorldFish, who co-funded the activities.

METHODOLOGY

The contents of this report are drawn mainly from the literature sourced through inter-library searches, the use of Google Scholar and Google web-based search engines. Information presented in the literature has been combined with first-hand data collected by the authors through a mixture of key informant interviews and focus group discussions (FGDs) in the Kamping Pouy and Boeng Sne irrigation schemes in Battambang and Prey Veng Provinces, respectively, in September 2012. These discussions were held with a range of stakeholders linked to the irrigation schemes and to local development at village, commune and provincial levels (Table 1). Efforts were made to ensure there was representation from villages situated at different points in the irrigation schemes, and from both men and women.

Kamping Pouy	Boeng Sne
Focus group discussions	
Kamping Pouy farmer water-user community (FWUC) members	Farmer water-user community, Teae Commune
Ta Ngen fisheries community members	Fisheries community members, Theae Commune
Takrin Commune Council (CC) Chief, other CC members and heads of two villages in Takrin Commune	Theay Commune Council Chief and heads of six villages in Theay Commune
Pnomsampau Commune agriculture cooperative (three villages inside the scheme)	
Key informant interviews	
Deputy Director, Provincial Department of Water	Officer-in-charge of main sluice gate and canal,
Resources Meteorology (PDoWRAM)	PDoWRAM, Ba Phnom (BP) District
Chief, Agriculture Extension Office, Battambang Province	Chief, Office of Agriculture Extension (OAE)
Deputy Director, Provincial Department of Agriculture (PDA)	Chief of Agriculture District
Chief of Fisheries Division, Battambang Province	Vice-Chief of Fishery Sector

Table 1: Stakeholder consultations in two case study sites

An attempt has been made to provide an up-to-date representation of the literature reviewed, with an emphasis on the more recent findings. Differences in results and opinion have been highlighted where they arise, to reflect the heterogeneity of the biophysical, geographical and socio-cultural contexts involved.

The first section deals with the main policy narratives, in terms of overall development directions and the positioning of agriculture and irrigation within the national development policy framework. Key policy objectives and their rationale are explained, along with some detail on strategic actions identified to reach these policy goals. An overview of performance of the agriculture sector, focussing on rice production, and the irrigation schemes is presented in the next section, followed by an unpacking of factors that explain the present status quo in the next section. In so doing, an attempt has been made to construct a holistic, multidisciplinary picture of the multiple drivers distributed across a range of sectoral spaces. This is to avoid simplifying the complexity of an issue, and to illustrate the need for intersectoral (or at least interdisciplinary) tools to address them. The following section discusses stated policy in light of the messages from the field coming through the existing literature and IWMI's fieldwork, and identifies implications of the current policy, especially for smallholder farmers. The conclusions in the last section seek to convert the analysis in the preceding sections into workable recommendations.

INTRODUCTION

The Cambodian Millennium Development Goals (MDGs) set ambitious future development targets for the country, including eradication of extreme poverty and cutting in half the proportion of people who suffer from hunger by 2015. These are ambitious goals, given that Cambodia is among the poorest countries in the world, with 34% of its mainly rural population living on less than a dollar a day and 15-20% living in extreme poverty (RGC 2010a). Over 80% of Cambodia's population (and more than 90% of its impoverished population) lives in rural areas. Thus, agriculture continues to be the mainstay of the economy, comprising 34% of the gross domestic product (GDP) and absorbing 60% of the total labor force (RGC 2010a). The Cambodian government positions agricultural and rural development as a priority issue in its efforts to achieve poverty reduction and economic growth. The country has relatively few economic resources except for its agriculture, fishery and forestry resources, few mineral resources (excluding recent indications of offshore reserves of oil and gas), limited hydropower potential and a small industrial base (ADB 2010). As rural agriculture is predominantly organized on the basis of smallholder farmer communities and families (Box 1), Cambodia's agriculture and water sector policies will inevitably have a significant bearing on the well-being of the rural and poor population who represent the primary target of the government's stated poverty reduction ambitions.

Box 1. Classification of irrigation scales

Small-scale irrigation (service area < 200 ha): the system is managed by the District Office of Water Resources and Meteorology (WRAM) or by PDoWRAM, if it is in more than one district; it is operated and maintained by the beneficiaries under WRAM supervision.

Medium-scale irrigation (service area 200–5,000 ha): the system is managed by PDoWRAM or by the Ministry of Water Resources and Meteorology (MoWRAM), if it is in more than one province. It is maintained by the PDoWRAM in cooperation with users and is repaired by MoWRAM.

Large-scale irrigation (> 5,000 ha): the system is managed and maintained by MoWRAM.

Source: CDRI 2008.

Central to these policy objectives is rice farming, which both dominates agricultural activities and production as well as rural livelihoods, lifestyles, values and customs. Since rice farming in Cambodia has traditionally been dependent on rainfall rather than irrigation, rainfall distribution determines the success and size of harvests (Wokker et al. 2011). Wet-season crops are grown in the rain-fed uplands, rain-fed lowlands and deepwater areas, and cover almost 2 million hectares (Mha) or nearly 90% of the rice-growing area in Cambodia (Rickman and Sinath 2004). Consequently, significant productivity gaps separate Cambodia into the productive southeastern Mekong floodplains and northwestern lowlands along the border to Thailand, and the less productive upland regions (Mund 2011). Due to a belief that this production scenario holds significant potential for yield gains through the provision of irrigation water, the government has been investing heavily in developing the country's irrigation infrastructure over the past two decades. Statistics from MoWRAM indicate that by 2010, 1,120,246 ha (dry season: 347,058 ha; wet season: 773,188 ha) were irrigated, accounting for approximately 43% of the total cultivated land area (CDRI 2010). This has involved the rehabilitation of existing irrigation schemes, with financial support from external donors and aid agencies (Thuon et al. 2007).

However, agricultural growth has, on average, lagged behind the industry and services sectors since the mid-1990s, with large fluctuations and even occasional negative growth recorded in the early 2000s. A resurgence has been seen since 2005 when the agriculture sector's performance has been consistently positive, with an increase in rice yields, from 1.8 tons (t)/ha in 1998 to 2.6 t/ha in 2007 and a near doubling of rice production, from 3.5 million tons in 1998 to 6.7 million tons in 2007 (Kimsun et al. 2011). The increased production is attributed to a combination of increased yields and an expanded area under production. As a result, Cambodia is now self-sufficient in rice and produces 2 million tons of exportable surplus according to ADB (2010). Nevertheless, there is a felt need to reassess the future role of agriculture in Cambodia's development in light of a growing number of studies that have sought to document the performance of many rehabilitated irrigation schemes, in terms of production and productivity, production and management efficiency, and the implications for smallholder farmers. Particular emphasis is placed on development policy which needs to balance the interests at the macro level with those of individuals, households and communities, and how present ground realities speak to current policy directions in the agriculture and irrigation sectors. This review, is intended to be a contribution to this discourse.

Agriculture as the primary engine of economic growth and poverty reduction

Given that 80% of Cambodians live in rural areas (CARD 2011), it is no surprise that agriculture sector development has, and continues to, occupy a central role in the country's primary development policies and strategies. Its dominance of rural livelihoods and its low productivity are seen by the government as reasons to identify significant developmental potential, in terms of contributing to GDP growth and poverty reduction at household level. Therefore, the Royal Government of Cambodia's (RGCs) **Rectangular Strategy for Growth, Employment, Equity and Efficiency**[1] (RS) sees agricultural development, and rehabilitation and construction of physical infrastructure, as central to alleviating poverty and enhancing economic growth. In fact, RGC aims to make agriculture a leading sector in the national economy and one that provides the foundation for sustainable economic growth (RGC 2010b). The **National Strategic Development Plan (NSDP) (2006–2010)** and its update covering the period 2009–2013, developed to operationalize the RS, emphasize investment in agriculture to overcome the core problems facing the sector: stagnant productivity, insufficient crop diversification, and underdeveloped and underperforming water resources. The updated NSDP recognizes that traditional engines of growth (tourism, garment exports and construction) must be complemented by more rural and broad-based sources (World Bank 2010). The government has prioritized the rice subsector, in particular, as the main sector for alleviating poverty, especially rural poverty. In 2010, the NSDP set a production target of 5.5 million tons for the rice sector, which was to be achieved through a yield increase from 2.0 t/ha in 2005 to 2.4 t/ha in 2010. This called for an expansion in the proportion of irrigated land (including supplemental irrigation) from 20% to 25% during the same period, and the irrigated rice area to increase from 588,687 ha to 650,000 ha. These targets were increased following the 2008 Mid-Term Review of NSDP, where the rice production target was revised to 7.5 million tons, requiring the rice yield to increase to 2.8 t/ha and the irrigated rice area to expand to 867,000 ha (Yu and Diao 2010).

The **Strategy for Agriculture and Water (SAW) (2010–2013)**, which operates within the NSDP framework, adopts a long-term development goal of sustainable and pro-poor management of water resources that envisages the integrated management of water and land resources in a river basin context. SAW also outlines several performance targets to be reached by the end of its term.

- The area of cropping land with access to irrigation services will be increased by 100,000 ha.
- The incidence of drought- or flood-affected farmland will be reduced by 20%.
- Agricultural output will be increased by 20%.
- Beneficiary income will be increased by 20%.
- Employment in the agribusiness and agro-industrial sectors will be increased by 20%.
- Area planted with cash crops will be increased by 20%.
- Value of agricultural exports will be increased by 30%.

In order to achieve these targets, SAW seeks to implement the following six programs (or 'pillars'):

A. Appropriate policy and legal frameworks in the agriculture and water sectors
B. Institutional capacity building and human resource development for effective agricultural and water resources development and management
C. Research and education to generate and use agricultural and water-related knowledge, information and technology transfer
D. Food security to ensure that resource-poor and food-insecure Cambodians have substantially improved physical and economic access to food that meet their dietary needs and food preferences
E. Integrated land and water resources management
F. Agricultural business and marketing that deliver real benefits to farmers, rural communities and other stakeholders

There are 24 components within these six pillars (detailed in Section 7 of SAW), which specify the objectives of each pillar. Pillar A focuses on developing and strengthening policy and regulatory frameworks, and their implementation in agricultural land management, marketing and the operation of farmer water-user communities (FWUCs). As Provincial Departments of Agriculture (PDAs) and Provincial Departments of Water Resources and Meteorology (PDoWRAMs) lack the capacity to deliver the technical services required under the law to provincial councils, SAW provides a budget and technical assistance to staff at PDAs and PDoWRAMs in three pilot provinces selected by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Water Resources and Meteorology (MoWRAM). Constraints on the use and management of agricultural lands will be identified, and policies for governance of agricultural lands will be ratified. This will include the introduction of policy and legal frameworks rationalizing the conversion of forestland to agricultural uses in light of the mitigation measures needed to address climate change. It also recognizes that the establishment of FWUCs requires considerable attention and a long-term program. The components in Pillar A include the identification of policies for recommendation to the national assembly, which provide some protection to farmers against prevalent agricultural imports. Seen as a first legal step towards nurturing the agribusiness industry, these polices will need to be non-distortive and compatible with existing trade agreements.

Pillar B seeks to introduce institutional mechanisms, mainly through financial and other incentives to staff, to improve service delivery of MAFF and MoWRAM. It also includes activities to improve and integrate their planning, budget and data and financial management systems. Improved dataset integration will facilitate planning of strategic interventions, monitoring and performance evaluation.

The investments proposed in Pillar C recognize that agriculture and water resources management in Cambodia are severely constrained by a lack of appropriately qualified technical personnel at national and sub-national levels. This component is designed to create a needs-based pool of trained people to meet the requirements of new and emerging technologies such as: biotechnology, hydraulics, conservation agriculture and market dynamics. This will provide a strong foundation of knowledge systems and human capital for delivering relevant, viable, farmer-centered and development-oriented services. This component seeks to build farmer capacities to overcome a range of environmental issues and production constraints (soil erosion and degradation; soil and water salinity; floods and drought; chemical pollution; river siltation; deforestation; loss of crop diversity and decline of fish stocks) by generating appropriate technologies and training resource-poor men and women farmers in prioritized technologies. Following training, farmers will be expected to participate in food processing, marketing and trading activities in support of their livelihoods, and will be more resilient to climate-induced uncertainties. It is estimated that in 2002, drought damaged more than 130,000 ha of rice, while floods damaged 40,000 ha, according to ADB (2012b). This approach is expected to ease post-harvest gaps that currently undermine the cost-effectiveness of production, processing and distribution as well as quality aspects that underpin market access and competitiveness. This will be facilitated by establishing a national food and agriculture processing technology center, staffed by trained and qualified researchers, to undertake research programs which generate value–added–market-oriented niche technologies that meet international standards.

Pillar D aims to improve the food security of 0.6 million individuals (approximately 120,000 households) through training in low-input and improved technical packages for food production. These interventions aim to target on-farm and off-farm groups for income generation support through training and links to off-farm employment opportunities, or small-scale agro-processing. This pillar also focuses on village-level institutional development and capacity building, and empowerment, through self-help groups including farmers' groups and farmer cooperatives (FCs). They will receive technical and input support, including credits for: intensification and diversification of agriculture; land and soil management, post-harvest practices; processing and marketing. Support also includes largerscale village irrigation development and management, and other village infrastructure. This component assumes that registration in farmer organizations will be decentralized to the district level.

Pillar E emphasizes the need for more water data and integrated water resources management (IWRM), and the continued development of irrigation and water management infrastructure through a more participatory and integrated design process. The IWRM component focuses on delineating and classifying river basins, developing a water management framework plan for the Tonle Sap Basin, and creating multi-stakeholder water basin committees. Pillar E seeks to strengthen FWUCs to achieve their mandate and facilitate the government's goal of rehabilitating or building 20,000 ha of wet season and 5,000 ha of dry season irrigation schemes per year, with direct participation from FWUCs. Pillar E aims to improve the productivity of lowland and upland rice soils, strengthen smallholder land tenure security and productivity and the management of state land. To support this, the land resource inventory will be updated, generating crop zones and rice soil maps through soil surveys that identify soil-limiting factors for crop production. In view of increasing land-use changes in the lowlands, sustainable techniques for soil fertility management and techniques for an integrated crop management (ICM) approach will be disseminated to farmers via the extension service. In the upland systems, where little is known about soils in the farming systems, extension workers will determine land suitability for field crops and train farmers in the use of sustainable soil fertility management techniques. Attention will be given to improving the management of social and economic land concessions (SLCs and ELCs) within a dual-track approach to land use and land tenure that uses a systematic land titling program for smallholder farmers (through SLCs[2]), while granting ELCs to private investors to support agribusiness development to generate rural off-farm employment and state revenue. SLCs for resource-poor smallholders focus on rice-growing areas in the Mekong and Tonle Sap river basins, and are seen as a way of enabling landless farmers to gain access to land for residential and subsistence farming—as temporary possession is not a route to legally acquiring land.[3] ELCs will be granted in frontier and forested areas, which implies conversion of forestland. This will be preceded by a review of the ELCs to examine their contributions to job creation, government revenues and poverty reduction. This is expected to improve procedures for granting ELCs, including their transparency and participatory nature. Additionally, an action plan for mechanisms to resolve land disputes, which focuses on poor and vulnerable rural households, will be developed.

The priorities for Pillar F include improvement of: farm inputs and farm production, extension and outreach services and market infrastructure, and the development of markets. It is recognized that poor access to quality and efficient inputs is a major impediment to improving agricultural productivity. Fertilizers and agrochemicals are imported informally across the border from Thailand and Vietnam in small quantities. Sample testing has shown that fertilizers can be diluted by up to 48% and there are no Khmer instructions on the label for usage. Thus, MAFF plans to support private sector importers to provide bulk fertilizer and agrochemical imports from their countries of manufacture, improving quality and reducing unit costs. Merchants will also be licensed to help ensure that standards are maintained. Cambodian agriculture is not mechanized due to the small size of land holdings. Having access to the appropriate machinery for land preparation, harvesting or on-farm post-harvest handling would allow expansion of

the area cultivated, which is currently limited by family labor. Pillar F aims to diversify agricultural production through extension and training, provided by the state and private sectors; to promote specific technologies and techniques; or address specific constraints such as diseases for specific crops. This will be supported by a study commissioned by MAFF, which will identify technologies for high-value crop production, including the use of tube wells and drip irrigation. Promotion of on-farm post-harvest handling techniques (e.g. drying, cleaning, grading, storage, packaging and transport) for specific cash crops will provide higher incomes for farmers. Similarly, linking producers to markets by providing information on opportunities, developing marketing strategies to reach those markets, and providing access to associated services (such as business planning and financing) will help producers realize higher and more regular incomes.

An important recognition made in SAW about its pro-poor aspirations is that the Rectangular Strategy (RS) or other key strategic documents have never clearly identified the role of smallholder agriculture in achieving growth, including export production (RGC 2010a). Since over 70% of Cambodians (about 9.5 million) are engaged in agriculture and the vast majority of them are smallholder farmers[4] (UNDP and Ministry of Environment 2011), ensuring that these farmers can significantly benefit from the many investments proposed in these policies will be central to the equitability of future agricultural development.

SAW was followed by the **Policy Paper on the Promotion of Paddy Production and Rice Export**, which sets short-, medium- and long-term measures and related investment priorities to transform Cambodia into a key rice-exporting country (Box 2). It envisages the export of one million tons of milled rice by 2015, which would require an overall rice surplus of 4 million tons. The policy proposes that, with an estimated domestic consumption of approximately 3.14 million tons of paddy rice and provision for seeds and harvest loss, the statistics show a surplus of 3.32 million tons, which can be processed into milled rice for export. Yet, the official statistics for 2009 show that only 13,000 tons of milled rice or 20,000 tons of paddy rice was exported, although Cambodia has actually exported much more milled rice. The gap between the supply surplus and official export figures reflects Cambodia's potential to increase the official export of milled rice in place of the informal export of unprocessed paddy rice. In fact, according to SAW, the rice sector could become an important pillar to sustain Cambodia's economic growth, while the garment sector is facing stiffer competition. If rice exports could reach 3 million tons, the export value would be US$ 2.1 billion (approximately 20% of GDP) or about US$ 600 million (approximately 5% of GDP) in value-added contribution to the national economy. The impacts on poverty is predicted to result from the employment of more than 70% of rural people and income increases through a ready market for rice at better prices, and from other spin-off economic activities such as cooking oil production, aquaculture and animal husbandry using the broken rice, husk and brain produced during rice milling. Moreover, it assumes that such developments will translate into an equitable redistribution of economic gains. The promotion of milled rice export is also viewed as the first step in catalyzing the export of other agricultural products such as rubber and other crops.

Box 2. The Policy Paper on the Promotion of Paddy Rice Production and Rice Export, 2010.

Measures for paddy rice production

Quick-win measures

- Increase paddy rice productivity by using high-yield seed varieties and modern farming techniques.
- Continue to expand irrigation: MoWRAM to improve the efficiency of water management on existing water resources.
- Continue to build and maintain rural roads.
- Promote microcredit for agriculture.

Medium to longer term measures

- Improve productivity and crop intensification
  - Enhance water management, which is key to crop productivity and intensification: MoWRAM and MAFF to develop a plan for Water Resources Management for the next 10-20 years, with a focus on investment in irrigation systems and water management as top priorities.
  - Increase investment to rehabilitate agricultural development stations.
  - Expand agricultural extension services at commune level.
- Promote implementation of the National Policy on Rural Electrification.
- Promote and establish farmer organizations.
- Promote and encourage the implementation of policy on the sustainable use of agriculture land -
  - The Ministry of Land Management, Urban Planning and Construction (MLMUPC) must give priorities to delivering land titles in the potential rice production areas to ensure land tenure security, reduce disputes and encourage investment in land.
  - MLMUPC must cooperate with MAFF and the agencies concerned to classify land-use zones.

Measures for paddy rice collection and processing

Quick-win measures

- Encourage participation of the private sector in paddy rice processing and milled rice export.
- Continue financing for paddy rice collection - financial mechanisms to make it easier for the communities, rice millers and exporters to access loans from sources such as commercial banks and credit facilities that are guaranteed by the government.
- Provide support and strengthen the Rice Millers Association (RMA) - the RGC will provide special treatment to the RMA in the same way that it has supported the Garment Manufacturers Association in Cambodia (GMAC).

Medium to longer term measures

- Create new financial instruments and leverage mechanism for financing.
- Establish and strengthen farmer organizations to develop the open paddy market through activities such as contract farming, weighing, drying and paddy-based collateralized loans for members, provision of high-quality seeds and fertilizers for market-driven rice production.
- Reduce electricity price and extend coverage areas.

In the short-term, the policy paper recommends promoting paddy rice production to meet local market demand and formal exporting of milled rice (instead of informal export of paddy rice). In the medium to long term, the emphasis is on enhancing competitiveness in rice export through the promotion of production technology; management of soil fertility, water, seeds and fertilizers; organization of farmer associations; improvement of rice processing quality; expansion of physical infrastructure, including roads, railways, seaports and electrical energy; improvement of land use and management; and provision of short- and long-term credit as well as trade facilitation and exploring market opportunities (ADB 2012a). Similar to SAW, this will include establishing partial credit guarantee instruments to encourage commercial bank lending to the rice milling sector, and increase competitiveness of rice milling to reduce the dependence on informal cross-border exports to neighboring countries. Although the small- and medium -sized enterprise (SME) sector accounts for about 75% of all employment in Cambodia, and agribusinesses represent a significant component of SMEs, its contribution to GDP is marginal, due to the informal nature of a large number of enterprises whose output is not captured in national statistics (World Bank 2010).

Irrigation as a fundamental condition for agricultural intensification and building resilience to climate change

The focus on agriculture has, surprisingly, not prompted an expected emphasis on irrigation infrastructure and its management. In fact, according to Thuon et al. (2007), the water sector is expected to make its greatest contribution to economic growth and poverty alleviation through irrigated agriculture and domestic water supply. This is because agricultural production in Cambodia is closely related to climatic conditions (UNDP and Ministry of Environment 2011), where 81% of annual precipitation occurs during the wet season (May to October) with seasonal concentration of precipitation even higher in some areas, such as Kampong Chhnang Province (84%) (Chanrith n.d.). Most of the agricultural zones depend on rainfall, and production is blighted by uncertainty, a single crop per year and non-diversification of local farming systems. Consequently, if dry-season (December to February) production is to contribute to an expanded agricultural output, all the water required for growing rice during this period must be supplied through irrigation, according to the Cambodia Development Resource Institute (CDRI) (Chem et al. 2011). The Rectangular Strategy (RS) places particular emphasis on increasing the area of irrigated land, with the expectation that irrigation will make farmers less reliant on rainfall and allow them to cultivate more crops with more certainty and predictability, resulting in higher productivity and improved livelihoods (Tong et al. 2011). SAW also recognizes that most soils in the lowlands have low fertility and are used under rain-fed conditions with significant fluctuations in nutrient and water availability. Consequently, rice yields remain relatively low. Raising the productivity of lowland agriculture remains a significant objective, and substantial hope is invested in full and/or supplementary irrigation as the catalyst for intensification and diversification of lowland cropping systems. Consequently, the government has allocated about 35% of the total national budget to the irrigation sector for producing more water for agriculture (Sinath 2007).

Improving the management of water resources and irrigation will also be addressed under the **Strategic Framework for Food Security and Nutrition in Cambodia (SFFSN) (2008–2012)**. The goal of SFFSN is that, "By 2012, poor and food-insecure Cambodians have substantially improved physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (RGC 2008). Irrigation, under this framework and in general, is targeted at reducing the dependency on rain-fed farming and strengthening the resilience of poor food-insecure farmers, including their ability to cope with natural disasters such as floods and drought, and increasing rainfall variability. The drive to expand irrigation is underpinned by the belief that the use of water systems for agriculture is nowhere near its full potential, as Cambodian agriculture remains predominantly rain-fed with traditional farming techniques (Nou 2005). Other studies support the belief in the potential for significant yield improvements. For instance, Halcrow (1994)

cited by (Chea 2010), estimates the yield from rain-fed cultivation to be lower than both wet-season cultivation supplemented by irrigation (73% higher) and dry-season irrigated cultivation (231% higher), suggesting that Cambodian agriculture is very responsive to irrigation. Consequently, investment in irrigation, including improvements in current irrigation systems and management, is among the top priorities of public investment in Cambodia (Yu and Diao 2010).

Amidst these many planned actions, the Policy Paper on the Promotion of Paddy Rice Production and Rice Export recognizes several factors that will determine the success of this policy which will apply to all the other policies and strategies discussed in this review:

- Paddy rice production is largely subject to weather conditions and climate change as well as the unpredictability of the Mekong River's water level in the dry season.
- Higher oil prices will directly affect the production, processing and transport of rice and other products.
- The milled rice market is highly protected.
- Opening up of the milled rice markets to promote exports would cause an increase in domestic prices, and the traditional mechanism of food stocking will become weak, threatening national food security.
- The gains from these interventions may not be shared directly with farmers, if they are captured by middlemen, exporters and suppliers of agricultural inputs. Since farmers have limited capacity, training will be essential to ensure their concerns are addressed in a participatory way.
- Paddy rice development areas use high levels of chemical fertilizers and pesticides, and the destruction of forest and flooded forest to expand the cultivated land area, are risks to natural ecosystems and the services they provide.
- Implementation could be difficult and complicated due to ineffective coordination and unclear responsibility among implementing ministries/agencies.

Decentralization of irrigation management through participatory irrigation management and development (PIMD)

Since 1994, the Cambodian Government has embarked on a program of transferring the responsibility of operation and maintenance (O&M) of irrigation schemes to FWUCs. The participatory irrigation management and development (PIMD) program was introduced in Cambodia to galvanize community participation in, and provide a sense of ownership of, irrigation schemes to achieve operational sustainability and economic development (at household and national levels) by improving system performance (Perera 2006). In 1999, PIMD was adopted as a formal policy with the Circular No. 1 on the Implementation Policy for Sustainable Irrigation Systems, which devolved responsibility for all aspects of irrigation scheme operation to FWUCs. Subsequently, farmer participation and the FWUC model were incorporated into the National Water Law as part of its formal PIMD strategy (Tong et al. 2011). The functions and responsibilities of the FWUCs can be summarized as follows:

- prepare the community's work plan
- develop the statute, contract and community's internal order
- maintain the irrigation system in good condition for timely water allocation
- manage and allocate water to community members
- increase the capacity of FWUC members on the use, maintenance and development of irrigation systems
- settle issues raised by community members
- collect irrigation service fees (ISF) according to the agreed amount set by the community (Nang et al. 2011).

The scope of these responsibilities encompasses the secondary and tertiary canal systems. At scheme scale, it should be noted that the reservoir and main canal fall under the direct responsibility of MoWRAM/PDoWRAM.

Once established and registered, a FWUC signs a management agreement with PDoWRAM outlining their roles and responsibilities, and indicating estimated ISF requirements. This is most commonly based on a template included in Circular No. 1 and, consequently, the mandated roles of FWUC are similar within each scheme (Chea et al. 2011). ISF collection is to be initially supported by the government, which begins by contributing 80% of the required ISF for O&M. This contribution is to decrease each year by 20% over 5 years. A third of the total ISF and any other funds received by the FWUC are to be allocated for emergency repair of the physical structure (Phallika 2012). Beyond these initial contributions to ISF, the role of PDoWRAM is limited to technical and managerial support, monitoring and evaluation, and other support needed by the FWUC.

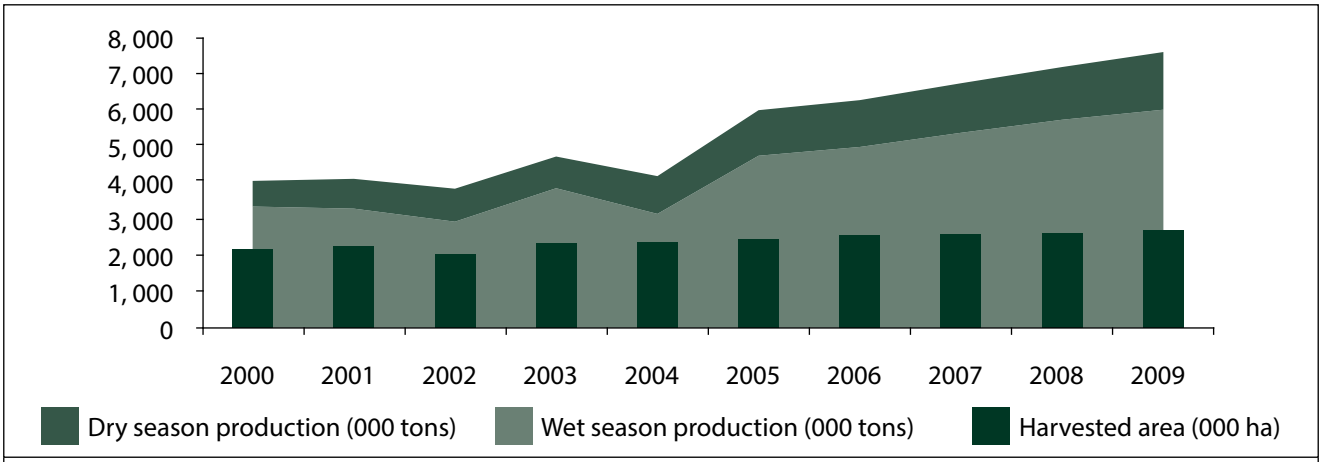
As stated by Chea (2010), a remarkable amount of hope and expectation has been placed on this policy, when one considers that it is expected to: contribute significantly to the effective and sustainable management of irrigation systems, promote food security and economic growth; increase the role of farmers and ease the burden on the government, build local capacity to manage irrigation, and bring about uniformity and consistency among donor, government and non-governmental organization (NGO) strategies for irrigation development and management. Thuon et al. (2007) believe the international donors have had a major influence on the Cambodian government's adoption of PIMD, in ridding the state of the fiscal burden of O&M of irrigation systems. Molle (2005) also notes the standardized and politically correct manner in which the then draft water policy affirms participation principles, suggesting a cookie-cutter approach to operationalizing participatory principles within a specific rural context.

In many cases, the FWUCs delegate tertiary canal management to the farmer water-user groups (FWUGs) whose rice fields cross such tertiary canals. As specified in Circular No. 1, FWUGs are FWUC subgroups and are normally led by the village chief (Nang et al. 2011). During wet- or dry-season rice cultivation, farmers are expected to report water demands to FWUG leaders who then ask the FWUC committee to release water from the secondary canal to the tertiary canal. When there are water shortages in the secondary canal, the relevant FWUC will contact PDoWRAM to release water from the main canal to the secondary canal. An example is the Stung Chinit scheme, where all matters related to such water allocations are discussed and solved during weekly or monthly meetings presided over by an external committee, of which the FWUCs, local authorities (LAs), district police and provincial departments (e.g. PDoWRAM, PDAFF and PDoE) are members. The external committee is presided over by the district governor (Nang et al. 2011).

PERFORMANCE OF IRRIGATED RICE PRODUCTION

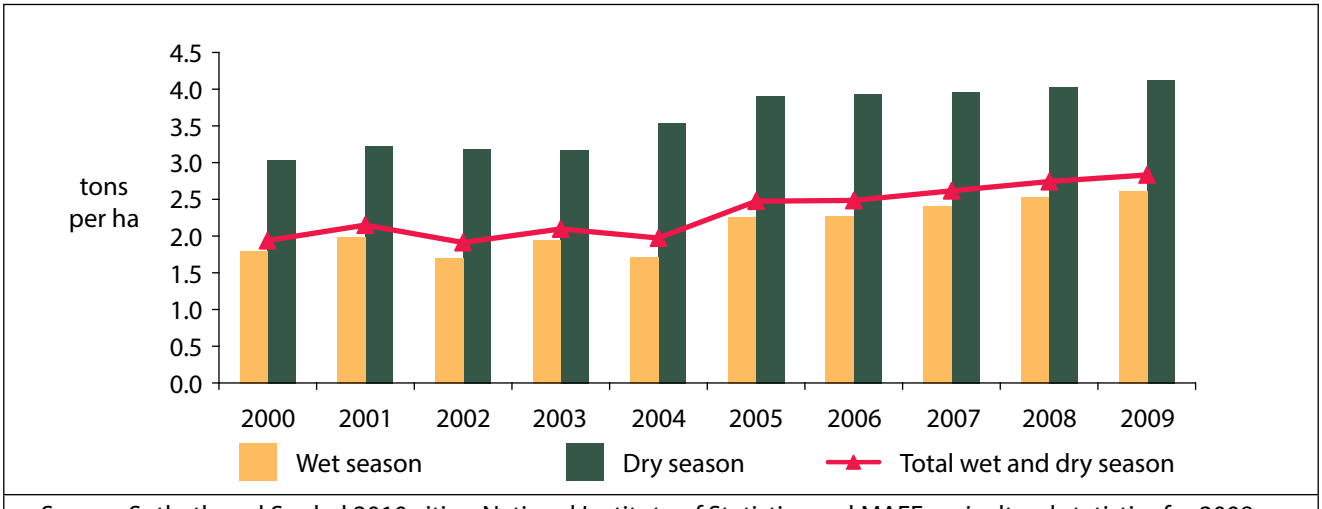
In the previous section, an impressive array of policies, strategies and proposed investments were outlined, which provides an overview of the complex and diverse cross-sectoral and cross-disciplinary nature of the conditions necessary for meeting policy objectives. These commitments amount to a major financial and implementation challenge, especially in the case of the limited time frame of SAW. The actual implementation challenge can be better understood to consider current experiences from the field level, which is the intention of this and the following sections.

The consistent trend of improving production (Figure 1) in the period 2005–2009 is encouraging. Sothath and Sophal (2010) partly attribute this to the expansion of cultivated areas and to improved productivity of paddy (Figure 2). On average, Cambodia's rice yield has increased by 5.4% per year since 1994, from 1.6 t/ha in 1994–1997, to 2.3 t/ha in 2003–2008. The wet-season yields increased from 1.0 t/ha in 1994 to over 2.3 t/ha in 2008. This yield increase has been largely attributed to improvements in access to fertilizers and other inputs, rather than improved varieties of seeds (ACI and CamConsult 2006). The productivity figures for dry-season crops are higher than those of the wet season crops, mainly due to the use of higher-yielding seed varieties and improved water management during the dry season. In addition, it is easier for farmers to apply fertilizers and treat the land for better production during the dry season (Yu and Fan 2009).



Source: Sothath and Sophal 2010 citing National Institute of Statistics and MAFF agricultural statistics for 2008

Figure 1: Evolution of agricultural land use and production, 2000–2009



Source: Sothath and Sophal 2010 citing National Institute of Statistics and MAFF agricultural statistics for 2008

Figure 2: Improvements in the productivity of paddy rice, 2000–2009

Sothath and Sophal (2010) ascribe the contributions of improved seeds, farming techniques, fertilizers and irrigation for these improvements. Thuon et al. (2007) point out that improvements in the rural road and market infrastructure have provided better access facilities for farmers to their fields and to local markets. A study of the Trapaing Trabek irrigation scheme (Kampong Chhnang Province) by Phallika (2012) concludes that, through the provision of both public and private irrigation, agricultural productivity has significantly improved, especially due to the expansion of the dry-season rice cropping area and a large increase in rice yield (on average, 6 t/ha when there is water and with the use of fertilizer, according to Chea (2010)). Irrigated area has expanded for public (from 20 to 450 ha during 1991–2010) and private (from 13 to 150 ha during 2006–2010) irrigation sources (Phallika 2012). This has enabled farmers to sell surplus rice and obtain some cash to use as capital, which has contributed to household poverty reduction in the study area. Once the poorest of the 13 communes within Kantuot District, the residents of Kantuot commune have now become amongst the richest (Chea 2010). Before 1991, there was no dry-season rice since there was no irrigation system. Cultivation was limited to some recession agriculture using floating rice. Following the irrigation scheme, the area irrigated has expanded each year along with the demand for labor, which has drawn seasonal labor from other villages in the same or neighboring communes (Phallika 2012).

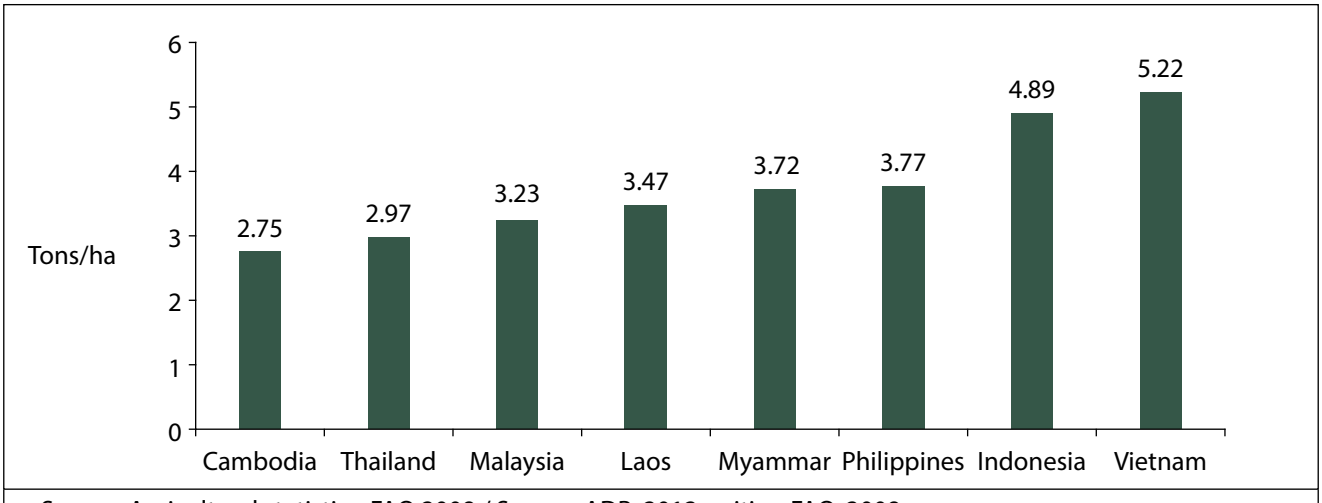
Similar examples are provided by other observers elsewhere. Thuon (2006) highlights Sdao Koang irrigation scheme in Prey Veng Province, where he finds that farmers recognize the improvements in their livelihoods. By increasing the average rice yield to 3 t/ha and also increasing fish availability in the irrigated paddy where farmers have fishponds, the scheme has enabled them to produce surplus rice for sale and the income is used to purchase tractors and pumps as well as televisions, which were almost absent prior to the scheme. In the Stung Chinit irrigation project, Thuon et al. (2007) reported that wet-season paddy yield increased by 87% for 74 out of 160 farmers. They attribute this to water availability and the use of fertilizer and new techniques. Others who had also diversified into vegetables and fruits expected watermelon production to double and vegetable production to increase by 50%. The total increase in income from farm products (paddy and other field crops) was KHR 500,000 (US$ 131) per family per year. Nevertheless, Thuon et al. (2007) note that the agro-economic impact is still low compared to the expected output put forward by the project proposal.

In a study that covered nine villages representing all four of Cambodia's main rural agroecological regions, CDRI (2012) demonstrated the potential for poverty reduction through agricultural growth. Krasang and Ba Baong villages experienced a sharp and sustained increase in agricultural income between 2001 and 2008. Farmers in these villages doubled or tripled their yields of wet- and dry-season rice in 2004/2005 and 2008 compared with 2001. Combined with increases in income from wage labor in Krasang and increased returns from fishing in Ba Baong, only 8% of panel households in Krasang and 16% in Ba Baong were classed as 'poor' in 2008. Adoption of modern farming techniques, particularly of the high-yielding rice variety IR66 and chemical fertilizers, lie behind the large increases in rice yields while the reliable supply of water, increasing availability of microcredit and construction of rural roads were other key factors. The almost doubling of the price for paddy in 2008 (compared with 2004/2005) also helped increase income from surplus paddy, and encouraged farmers to change from subsistence farming to modern methods of farming. Intensification and diversification of agricultural production by growing cash crops, such as peanuts, green beans and corn, and raising livestock was observed in Ba Baong, Krasang, Khsach Chi Ros and Kompong Tnoat, which helped to improve both household nutrition and incomes. Following the adoption of the high-yielding rice variety IR66, some areas, such as Khsach Chi Ros has become a dynamic dry-season rice-growing and surplus-producing area.

Nevertheless, Sothath and Sophal (2010) highlight the major role played by good weather/rainfall, which indicates an inherent vulnerability in Cambodia's agriculture that remains to be addressed. The same authors also add floods or drought to the climatic factors that continue to undermine food (and income) security. In this respect, the role played by irrigation is critical in decreasing the impact of natural weather events and allowing average better productivity (TWGAW 2006a).

Despite several examples of productivity and livelihood improvements following the introduction/rehabilitation of irrigation schemes, several observers consider agricultural productivity to be low, overall. Considering current irrigation performance, Thuon et al. (2007) conclude that, although Cambodia has more than 2,000 irrigation schemes which could potentially irrigate more than 1 million ha, most of these schemes are underperforming. Recent studies (ADB 2011a; ADB 2012a) found that agricultural productivity in Cambodia remains among the lowest in Asia and the Pacific (Figure 3). In fact, and contrary to the assumption in current policies, a national survey carried out by the Cambodia Development Resource Institute (CDRI 2008) revealed that only 35% of Cambodian farm households produce a paddy rice surplus, and the rest produce less than required or just enough for consumption. This is significant, given that over 80% of the population relies on agriculture as their primary source of income and where rice constitutes 90% of total agricultural output. Consequently, Sothath and Sophal (2010), through a study of 1,070 households in 15 representative villages across Cambodia, suggest that 61% of the surveyed households in rural villages would encounter food insecurity during August–October 2009. This is despite agricultural production generating a 3.5 million ton surplus in 2009, and being preceded by a steady rise in production, especially since 2005.

Furthermore, the government (RGC 2010a) recognized that farmers were not diversifying into high-value crops (e.g. off-season vegetables), and that agricultural production was based upon small, fragmented farms, which were producing primarily for subsistence needs. Farmers' lack of familiarity and limited knowledge of non-rice crops as well as unpredictable rainfall, have led to the perception that diversifying from paddy to the cultivation of other crops is highly risky. Consequently, market infrastructure for non-rice crops is underdeveloped. In addition to the availability of water, there were other important factors that had affected farmers' willingness to diversify from paddy to the cultivation of other crops, e.g. farm size; household head characteristics, including education and experience; resource endowment, especially farm assets and the number of plots occupied; markets; and the desire for higher incomes (Tong at al. 2011). This has led to some analysts (e.g. CARD, 2011) questioning how far small-scale food-insecure farmers are benefitting from recent investments in the agriculture and water sectors. Further reason to pose such a question arises in view of the government's continued practice of granting large-scale economic land concessions (ELCs) to private sector investors under a sub-decree on ELCs (2005),[5] which allows investors to obtain large amounts of land (up to 10,000 ha) for agricultural production and agro-industry development. Sothath and Sophal (2010) found that by April 2010, 87 ELCs had been granted (which cover more than 1 million ha), even though the Agriculture Sector Strategic Development Plan (ASSDP) 2006–2010 and SAW claim that they seek to support smallholder farmers over large-scale agriculture and call for a review of the ELC process (RGC 2010a).



Source: Agricultural statistics, FAO 2008./ Source: ADB, 2012a, citing FAO, 2008.

Figure 3: Productivity of paddy in Cambodia compared to other countries in the region

This section presents a range of diverse conditions and constraints that could have an effect on agricultural production, and highlights some of the realities shaping the broader context within which Cambodia's agriculture and water and related development policies will be implemented. While scheme management, production and post-harvest issues are covered separately, in practice, farmers, especially small-scale operators, are likely to be affected by a combination of factors. These occur at different stages of production, and form a continuum along the production and post-production stages. Nevertheless, in the literature reviewed, inadequate fertilizer use and underdeveloped irrigation facilities are seen as the most binding constraints to agricultural production. For example, a survey conducted by the Economic Institute of Cambodia (EIC) reveals that, for a majority of farmers, the top three factors affecting crop yields are: lack of an irrigation network; obsolete tools; and counterfeit, and high cost of, fertilizer.

Poor system design and management

While irrigation has certainly contributed to the productivity gains recorded in recent years, the literature and key policy documents on agriculture and irrigation suggest that this has occurred despite significant system inefficiencies, and serious questions were raised about their economic viability (ADB 2008a; CEDAC 2010). This section seeks to identify the diversity of factors shaping this status quo, with a view to identifying their implications on where future investments in irrigation should be directed.

Inherent geographical and biophysical challenges

The factors identified in this subsection are constraints to system functioning, but can be viewed as challenges to the effectiveness of system design and management in terms of how they cope with the limitations and uncertainties these factors bring about. This aspect will be discussed later on in this subsection.

Hydrology, geography and physical water scarcity

What CDRI (2010) describe as Cambodia's unique hydrologic regime has meant that some rivers have too much water flowing in the rainy season or too little water, if at all, in the dry season, when water is needed the most for irrigation. This water flow regime is less than ideal for the optimal operation of irrigation systems. Consequently, different parts of Cambodia are afflicted by physical and/or economic water scarcity. Chea et al. (2011) provide the examples of Rolous (near Boeung Lies, Kampong Thom Province) and Damnak Ampil (DAP) in Pursat Province. In Rolous, water is physically scarce at the sub-scheme level in the northwestern region, while the scheme also suffers from economic scarcity through severely underdeveloped infrastructure. There is an intrinsic shortage of water in Damnak Ampil, where even upstream users feel that there is not enough water, while the absence of concrete canals between schemes makes distributing water from upstream schemes to DAP unfeasible. Allowing the water to flow through the river would result in substantial losses through infiltration and evaporation.

Not only does physical water scarcity bring significant risks to crop production, especially during the dry season, it also poses a major challenge to the authority and credibility of FWUCs as farmers compete for water. CDRI (2010) observes another dimension to this problem in the expansion of the command area by farmers beyond what is technically feasible, often in defiance of FWUC and PDoWRAM advice, and cite the Trapaing Trabek and Pok Pen schemes as examples.

The Stung Chinit Irrigation and Rural Infrastructure Project and the Northwest Irrigation Sector Project, ADB (2010) highlighted the fact that policy emphasis on irrigation is underwritten by the assumption that, because the country's almost exclusive crop is paddy, timely water provision is critical to ensuring harvests and increasing production. The report points out that this flies in the face of Cambodia's hydrological and geographical realities. Its landscape and water availability make it almost impossible to store and move irrigation water using conventional methods due to a flat terrain, sparse dry-season rainfall, and the almost total absence of suitable landscapes for the construction of major structures to store wet-season water for use in the dry season. The need to ensure scarce dry-season water supplies for multiple uses (including domestic water supply) also acts as a constraint to the potential for irrigation in the country. The limited technical and institutional capacity of MoWRAM and PDoWRAMs further constrain the potential for any kind of sophisticated or complex irrigation development.

Poor and variable soil quality

One of the factors limiting productivity of paddy is the fertility of soil (Sothath and Sophal 2010; ADB 2012a). Half of Cambodia's agricultural land is classified as having poor quality soil, which is usually sandy and has only small quantities of nutrients. As a result, farmers have to incur higher production costs (more seed and fertilizer) for paddy cultivation. In fact, UNDP and Ministry of Environment (2011) noted that questions persist with regard to the viability of irrigation under such soil conditions.

Climate variability

According to Chea et al. (2011), water shortages have been a serious issue for farmers in Pursat (DAP scheme), where periods of drought have occurred in the wet season in the last few years and are becoming longer each year. This is forcing farmers with fields far from the irrigation canals to resort to pumping water to supplement rainfall. While this strategy helps mitigate crop losses, it can significantly erode farmers' profits, given the higher costs involved compared to irrigation water (discussed below). According to UNDP and Ministry of Environment (2011), predictions suggest that wet seasons will be shorter but with higher levels of rainfall and dry seasons will be longer and drier, resulting in intra-country shifts in the distribution of rainfall. The changes to the length of seasons, combined with the delayed onset of the wet season after a longer dry season, will affect traditional cropping practices and is expected to reduce rice yields (under both high and low emission scenarios) by at least 20% and increasing to as much as 70% of current production (UNDP and Ministry of Environment 2011). The field dialogues with farmers undertaken by IWMI in the Kamping Pouy and Boeng Sne irrigation schemes in Battambang and Prey Veng provinces, respectively (de Silva and Senaratna-Sellamuttu 2012), further support the growing concern amongst farmers over rainfall uncertainty and its influence on their choices of rice varieties and cropping patterns.

Unsuitable system design and poor quality of construction

An assessment of 2,525 irrigation schemes across 13 provinces by CEDAC (2009) found that only 23% functioned during the dry season, 49% functioned during the wet season, and 23% functioned during both seasons. The study also classified the schemes into three categories: well-functioning, functioning and not functioning. The classification was based on the quality of the reservoir, dam, structures and distribution network. Those schemes that were at least 60% in line with the original design were categorized as well-functioning, 40% to 60% in line with the original design were functioning and less than 40% who were in line with the original design were considered as non-functioning. The results showed that of the 2,525 schemes, only 6% were functioning well, 32% were functioning partially and 62% were non-functioning. CEDAC (2010) concluded that more than 2,400 schemes needed rehabilitation or reconstruction.

A common cause of operational problems in irrigation schemes is the way they were designed and/or constructed (CDRI 2010). Some of the schemes date back to the Angkorian period (Chea 2010), while many others were misconceived under the Pol Pot regime during the latter half of the 1970s. Chea et al. (2011) found that most schemes were not designed to cope in a context where physical scarcity in the dry season is a growing issue, with increased double-cropping taking place, as most schemes were originally designed and built for wet-season supplementary irrigation only. Therefore, the schemes cannot maintain enough water during the wet season for use in the dry season (CDRI 2010). Flawed designs in relation to hydrological and geographical realities have contributed to several existing schemes frequently being in disrepair, where failure is already built into the design and/or construction (Irrigation Development in Cambodia in 2011).[6]

Consequently, according to Perera (2006), such irrigation schemes simply cannot provide better services because of their faulty design, and this is true particularly of the systems built during the Pol Pot regime, which account for 69% of total irrigation systems. This leads to water scarcity and conflicts arising from the inability to distribute allocated water to all of the farmers within the scheme (Perera 2006; Vuthy and Ra 2010), cross-scheme conflict (Box 3) and differences in crop productivity and food security and incomes. Poor distribution infrastructure forces farmers to irrigate from plot to plot, which wastes water and contributes to water shortages downstream (Chem and Someth 2011).

Thuon et al. (2007) emphasize the importance of a sound design to withstand high annual rainfall and floods. They compare and contrast the 'modern' irrigation schemes in this respect to the traditional wet season flood-recession paddy cultivation that has been adapted to this reality. They argue that if new schemes are to be sustainable, they should be designed to withstand annual floods and high rainfall levels, or the annual O&M costs for system repair and improvement would remain beyond the capacity of the ordinary farmers.

Box 3. Cross-scheme conflict

Quoting Chea et al. (2011):
The situation in Rolous demonstrates the coordination struggles and conflicts that arise over water allocation at sub-scheme level, between upstream and downstream water users with differing water needs. The environmental issues are annual flooding of Rolous and Sroyov areas, which began to occur after the renovation of the Rolous irrigation dam, and poor water allocation at the command area. These have been the primary causes of conflict between farmers. There are essentially four groups of water users in the Rolous scheme, which require water at different times of the year and in different quantities. The first group consists of O Kunthor farmers living to the east of the main, privately owned, canal near Boeung Lies. The second group comprises farmers living and farming near Rolous village in the southwest. The third group consists of the private fishing lot owners operating in Prek Sbov stream and the fourth includes those farmers with fields in the central to northeast region of the scheme. The irrigation infrastructure does not meet the quantity, or the temporal demands of these four water user groups. Every year, the FWUC committee, with the support of the CC and PDoWRAM, has lobbied the FWUC farmers to discuss and negotiate water allocation strategies for the wet season. However, the actual beneficial outcomes of these efforts had been few, especially for the farmers in the Rolous village area whose problems cannot be solved without fundamental redevelopment of the scheme's infrastructure.

Sothath and Sophal (2010) found that lack of water in the irrigation system was reported as being a problem by 85% of farm households in Takeo and Kandal provinces. Another 48% and 39%, respectively, complained about the lack of distribution systems and the lack of water diversion systems in existing irrigation schemes. They conclude that secondary and tertiary canals were often not complemented, and the inadequate availability of water in the main canals was common (ADB 2008a). Others have noted an absence of drainage network and a large capacity of canals compared to the area irrigated (MoWRAM n.d.). This was also verified by IWMI's fieldwork (de Silva and Senaratna-Sellamuttu 2012) in the Kamping Pouy and Boeng Sne irrigation schemes, respectively, where both schemes which originated from the Pol Pot era, have been restored and extended in a piecemeal fashion which has left the secondary and tertiary canals incomplete. Consequently, according to JICA (2011), of the approximately 2.25 million ha of paddy fields in Cambodia (2008 figures), approximately 580,000 ha (or 26% of this area) were irrigated.

Nang et al. (2011) present the lack of community involvement in decision-making processes about irrigation development projects (e.g. schemes in Kampong Chhnang and Pursat Provinces), including initial appraisal, planning, implementation, and monitoring and evaluation, as another reason for poor system design. This has discouraged farmers from meaningful participating in FWUCs. According to Thuon et al. (2007), in Stung Chinit, problems related to canal improvement, such as designing narrow bridges, crosscutting the ox-cart tracks and lack of cattle crossing across the field channel, could have been avoided if community and local leaders had been consulted earlier. According to CDRI (2008), some of the schemes were built without the participation of key local stakeholders in the early stages of design and development, and their reservoirs were built at a level lower than the main canal, which prevented water flowing into the canal. Farmers were not willing to participate in the O&M of the schemes once they were handed over to them.

Expensive and unregulated private pumping due to geography, physical water scarcity and poor system design

Another consequence of water scarcity and poor system design is the prevalence of pumping of water from perennial watercourses and lakes, groundwater or dug ponds (CDRI 2008) in the absence of irrigation water. This takes various forms, including state-supplied pumps, cheap portable pumps used by individual farmers, and large pumping stations owned and operated by private businesses. The Trapaing Trabek irrigation scheme (Kampong Chhnang Province), for instance, cannot be expanded due to a landscape unsuited to gravity-fed irrigation, and thus exposition of irrigated area is based on pumping water from a nearby lake (Phallika 2012).

The RGC encourages such strategies because it provides rapid access to water for individual farmers. However, there is little regulation in place to avoid exploitation, especially of aquifers. Moreover, Sinath (2007) concluded that the experience in Cambodia with fixed pump schemes has been disappointing for a number of reasons. These include: inadequate water sources, siltation, over-dimensioning of pumps, use of fuel-inefficient Soviet-designed pumps, and high maintenance costs. Although the capital costs of pumped abstraction tend to be less than for gravity diversion, annual O&M costs for pump stations are significantly higher—about US$ 80/ha/year against US$ 20–25/ha/year for gravity irrigation schemes. In the Trapaing Trabek irrigation scheme, for example, Phallika (2012) reports that the water fee charged by the privately run pumping station is about 17–20 times higher than the ISF charged by the FWUC: US$ 87.5–100 (private) versus US$ 5–7.5 (FWUC). What is interesting is the inelasticity in demand between different household income categories, since farmers with land closer to the pumping station and invariably further from areas served by the irrigation canals had little choice. Although Phallika (2012) has not addressed this, it may be fair to assume that this additional production cost falls disproportionately on the poorer households, as they are more likely to own the more marginalized land within a scheme. If this is the case, the potentially negative impact on the poverty reduction objective of providing irrigation water is clear.

Underlying the cost of pumped water, is the absence of a clear regulatory framework for the establishment, operation and pricing involved in privately pumped water. In the above example, Phallika (2012) observes the informality characterizing the commencement and operation of the pumping station where the commune chief had approached a business-owner he knew and suggested that he start such a venture. Thus, the same author notes that none of the rules (e.g. registration, licensing) and charges (licence fees, taxes) applicable to creation of other private enterprises applies in practice to such schemes. The water fee is based on the petroleum cost in the market in the province, and the costs involved in the logistics to be managed by the pump operator. This involves an outlay of between US$ 3,000–4,000 for petroleum before the water fee is collected at the end of the harvesting period. The lack of rules also adversely affects the pump owner, since he has no recourse to a formal mechanism (such as a supply agreement) to collect the water fees when some farmers default, especially when they have suffered poor yields.

Poor performance of FWUCs in the operation and maintenance of irrigation schemes

The poor operation and maintenance has been highlighted as a weak point in nearly all the irrigation schemes visited by MoWRAM. As Perera (2006) recognized, implementing PIMD in Cambodia under many existing unfavorable conditions, including high levels of poverty, low agricultural productivity and deteriorated irrigation systems with frequently poor design, is a very difficult task. This observation seems to predict the finding by CEDAC (2009) that, only 230 (6.3%) out of 2,525 irrigation schemes across 13 provinces had a FWUC (Table 2), and of those 230, only four (2%) could be considered to be functioning well, though another 84 (36%) had the potential to do so, with the majority (62%) found to be non functional (Table 3).[7] Nang et al. (2011) found that, at a scheme level, the overall achievement of the primary purpose of FWUCs in managing, maintaining and operating small- and medium-scale irrigation schemes in a sustainable

No.	Province	Total number of irrigation schemes	Total number of FWUC	No. FWUC
1	Kampong Thom	488	39	449
2	Banteay Mancheay	94	28	71
3	Batambang	132	6	131
4	Pusat	57	9	50
5	Kampong Chhang	101	18	95
6	Prey Veng	261	27	234
7	Siem Reap	250	10	247
8	Svay Rieng	28	11	18
9	Kampot	45	6	40
10	Kampong Speu	374	22	368
11	Takeo	244	17	228
12	Kandal	108	6	104
13	Kampong Cham	343	31	331
		2,525	230	2,366
Source: CEDAC 2009				

Table 2: FWUC inventory from 13 provinces

No.	Province	Total FWUC	FWUC function well	FWUC could function	FWUC does not function
1	Kampong Thom	39	1	9	29
2	Banteay Mancheay	28	1	2	25
3	Batambang	6		1	5
4	Pusat	9		5	4
5	Kampong Chhang	18		6	12
6	Prey Veng	27		27	
7	Siem Reap	10		3	7
8	Svay Rieng	11		3	7
9	Kampot	6	1	2	3
10	Kampong Speu	22	1	5	16
11	Takeo	17		16	1
12	Kandal	6		4	2
13	Kampong Cham	31		3	28
		230	4	84	142
Source: CEDAC 2009					

Table 3: FWUC performance

manner was not being reached. Village-level findings indicated a significant disparity between the formally granted mandate to FWUCs and their effectiveness, including their difficulties in collecting ISF. Chea et al. (2011) found that, across case study schemes, FWUCs acted as a mediator between farmers and PDoWRAM, rather than carrying out their principal mandate of competently managing the schemes. They found that the performance of key tasks such as: maintaining infrastructure, allocating water from primary and secondary canals, and collecting irrigation service fees, were inconsistent and often absent. Many farmers who grow dry-season rice did not have irrigated water. The lack of irrigated water is due to a lack of water and irrigation infrastructure in the catchment, and a proper water allocation mechanism. Consequently, the allocation of irrigation water between different irrigation schemes and between users within the same scheme was not timely or equitable. This created intense competition over water (Chem and Someth 2011). Chea et al. (2011) concluded that the current governance arrangements deviate from the requirements imposed by the physical configuration of the schemes and the idealized theoretical governance purported in the PIMD policies.

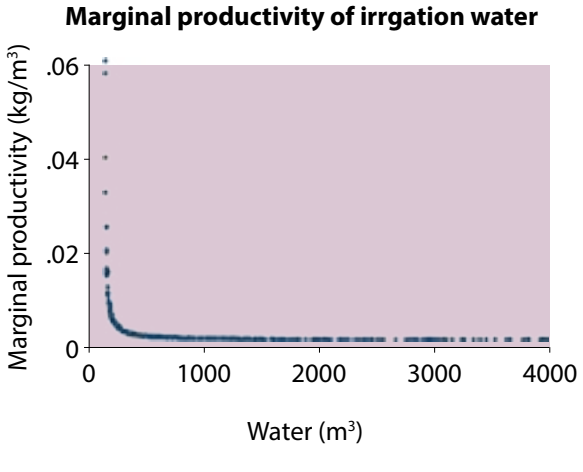
The reasons for this situation are multiple, and although these are discussed individually below, many are mutually reinforcing circumstances.

Inability to maintain the physical system

FWUCs do not have the financial capacity to undertake large-scale repairs. Sometimes, even routine maintenance is not carried out due to lack of funds (MoWRAM n.d.). There is a general inability to collect the ISF required to cover full O&M of the system. FWUCs collect a small proportion of ISFs, with only 45% of the infrastructure benefitting from some kind of routine maintenance (TWGAW 2006b), and the objectives of PIMD are not being achieved in many areas (CDRI 2008). Nang et al. (2011) concluded that given the general condition of the irrigation schemes, the current PIMD cannot encourage farmers to pay the water service fees or in participate in the O&M due to the lack of, or poorly constructed, infrastructure as well as other factors influencing the profitability of farming. A common sentiment expressed by farmers is that they do not want to pay ISFs if they did not benefit directly from the scheme.

CDRI, CARD and IFPRI (2011) found that farmers are sensitive to any changes in water fees. Estimates of the extra yield produced as a result of irrigation, when measured in terms of rice production, are very low—a 1% increase in the amount of water used increased rice yield by only 0.06% in the wet season and 0.12% in the dry season (Figure 4). For amounts of water larger than 1,000 cubic meters (m^3) per plot (controlling for other inputs), very little is added to yield size. These results led to the overall findings that raising water fees 'too much' will not lead to increased revenue for FWUCs, and farmers are acutely sensitive to changes in water fees above a relatively low value.

Chea et al. (2011) noted that local people misunderstood the purpose of water user fees and this was another reason for the failure in ISF collection. Since ISF is commonly translated into Khmer as 'water fee' rather than 'infrastructure fee', they suggest that Cambodian farmers actually believe they are being asked to pay for water rather than for the upkeep of the infrastructure necessary to supply the water. They cite farmers from DAP who claimed that Cambodians have never had to pay for water to grow rice, and they believed that they could get sufficient water from rainfall without having to pay the ISF. Similar views were found by Phallika (2012) in the Trapaing Trabek irrigation scheme (Kampong Chhnang Province), where the level of participation in O&M is still marginal and the FWUC struggles to collect the ISF, since water has always been viewed as a free resource and, traditionally farmers have never paid for irrigation water.



Source: Wokker et al. 2011

Figure 4: Marginal productivity of irrigation water

However, the determining factor appears to be the cost-benefit equation. As Thuon et al. (2007) put it, it is highly improbable that the farmers would be ready to bear the high operation and maintenance costs unless the scheme can generate a substantial increase in farmers' incomes and other tangible benefits. The FWUC in the Stung Chinit irrigation scheme would increase the ISF from KHR 30,000 to KHR 60,000 ha/year (approximately US$ 15), since the ISF collected could only support 50–60% of O&M costs. This, however, is not feasible since farmers are unlikely to pay a higher ISF while their rice production remains at the same level (CDRI 2008). The situation is similar in many other schemes, including the Tuk Chhar system (Kampong Cham Province), where ISF collection falls below the O&M budget and fees are already high while yields remain low (Thuon et al. 2007). Moreover, the situation is likely to worsen as a scheme ages, as illustrated by Thuon (2006) by the Sdao Koang irrigation scheme (Prey Veng Province). In this scheme, although the FWUC was well managed and at least 93% of ISF was paid, its long-term sustainability depends on the ability to increase the ISF to support impending repairs to broken water gates and broken canals and replacement of the aging pump. While farmers hold the poor quality of construction as being responsible for this, the burden falls squarely on them after PIMD.

As a consequence of inadequate ISF collection, FWUCs remain dependent on the commune support fund (approximately KHR 7 million for 2008–2009) and emergency funds from PDoWRAM (CDRI 2008), other state agencies (LAs; PDAFF; Provincial Department of Rural Development (PDRD); Provincial Department of Land Management, Urban Planning and Construction; PDoE; and PFiA) as well as NGOs and donors for maintenance of the scheme (Nang et al. 2011). The government recognizes that it is necessary that MoWRAM, through PDoWRAM, provides more assistance (financially, technically and in ISF collection) to FWUCs (MoWRAM n.d.); that the sharing of O&M responsibilities between MoWRAM and the FWUCs is rarely clarified; and that MoWRAM's maintenance budget for irrigation infrastructure is insufficient (RGC 2010a).

In addition to the issue of finance, Thuon et al. (2007) point out that the canal system and associated operational practices of modern irrigation schemes are new and complicated for farmers. Construction of drainage canals using a new design system is a new concept in Cambodia. If the drainage canals lack proper maintenance, which is the farmer's responsibility, they would soon disappear, resulting in failure of the scheme. Farmers are often unable to appreciate the importance of regular maintenance of the modern irrigation schemes. Their high maintenance costs means that some farmers think that the irrigation systems built during the Pol Pot regime were better as they were simple and easy to operate and maintain (Thuon et al. 2007).

Lack of legitimacy

In theory, FWUCs have a legitimate role in managing irrigation water, but do not have the power to regulate and manage water resources. It was observed that at scheme and catchment levels, the legal and administrative responsibilities of the FWUCs over the irrigation scheme is not effective for many reasons, including limited power and authority, limited support funds (as discussed above), inadequate capacity, and lack of human resources. Additionally, there are few accountability mechanisms in the FWUC governance structure, resulting in low levels of trust and poor public service delivery for most farmers and their neighboring FWUCs (upstream and downstream). In many schemes (Taing Krasaing, Wat Leap and Kampang), FWUC committees have abandoned their duties and even their interests (rice fields) which fall within the scheme (Nang et al. 2011).

Questions of legitimacy of the FWUCs arise early and are caused by difficulties and delays in FWUC registration.[8] According to Nang et al. (2011), some FWUCs reported having to wait several months or years to receive formal government recognition. Chea et al. (2011) found that recognition of FWUC legitimacy was strongest at PDoWRAM level, while villagers and MoWRAM did not always fully recognize the FWUC as a legitimate governance body. They cite the Rolous scheme, which, despite having an operational FWUC since 2004, has not been registered with MoWRAM. Consequently, some farmers had little trust in the FWUC's ability to manage the scheme.

Inability to exercise authority and loss of independence

Inability to exercise authority and loss of independence is a fundamental problem with multiple causes, many of which are mutually reinforcing. Chea et al. (2011) note that farmers' perception of the technical capacity of their FWUC is important, and is influenced by the infrastructural limitations of the scheme. These limitations lead to cyclical problems of water delivery, causing poor ISF collection and then degrading infrastructure which lead to further delivery issues, and so on. The failure to respond quickly and adequately to the urgent need to repair infrastructure damaged by the Ketsana storm in Rolous in 2009 created distrust amongst a number of farmers (Chea et al. 2011).

Undermined authority results in the inability to enforce system operation rules. Nang et al. (2011) found that releasing water without authorization and damaging canals or building small dams for fishing were the most common illegal activities. They point out that despite being independent organizations with a mandate to coordinate and facilitate local water-related issues, FWUCs lack formal conflict resolution powers, and cannot take any measures against non compliant farmers. Their role is merely to inform the LA, in the hope that some enforcement measures may be taken. In O Svay scheme (Kampong Thom Province), the FWUC is mandated to allocate water and to coordinate with the LA, which by virtue of the law, is empowered to punish illegal activities in irrigation schemes (Nang et al. 2011). Failure to coordinate with the LA has meant that the FWUC cannot enforce its rules on allocation and this has caused farmers to be less interested in participating in the FWUC, turning instead to commune councils to solve any water-use conflicts. These aspects reach a critical point during times of water scarcity when beneficiaries, facing crop losses and financial ruin, prioritize their individual interests over group interests (Nang et al. 2011). Such scenarios further emphasize the lack of more strategic planning by the FWUCs in relation to water allocation over longer periods of time (e.g. entire cropping seasons), which could mitigate the chaos sparked by unexpected water scarcity.

Nang et al. (2011) also found that FWUC independence is further weakened by their dependence on local political actors. In the Kampang scheme in Pursat Province, the FWUC relied on the commune council to perform some of its water management duties, as the committee members were too busy with other (non-water related) matters. Perera (2006) found that most FWUC activities were implemented under the direction of the commune chief. These informal governance arrangements undermine the independence that FWUCs are meant to have when managing local water resources. A lack of human resources and technical capacity are major reasons for this. Nang et al. (2011) found that according to FWUC members in many of the studied schemes of the three provinces (Kampong Chhnang, Pursat and Kampong Thom), FWUCs and farmers still rely on the coordination or support of local political hierarchies, including commune councils, district authorities and line agencies, to make important decisions. They found that FWUCs only wield real influence from within the commune council framework rather than independently of it. For example, in Svay Check scheme of Kampong Thom Province, the village chief was selected as the first vice chairman of the FWUC. In the Rolous, Stung Chinit and Damnak Ampil schemes, Chea et al. (2011) found that farmers reported issues on water allocation, infrastructure and conflicts to their FWUC, which would usually report the problem to PDoWRAM, which would design a solution and feed instructions back to the FWUC. They found that the FWUCs held little authority within their respective schemes, and were not fully aware of the extent of their mandate, especially in relation to that of the commune councils. Consequently, considerable diffusion of responsibility was observed, both among FWUC members and commune councils. In addition to their practical deficiencies, FWUCs struggle to operate within the firmly embedded, pre-existing traditional governance structure and the cultural patron-client hierarchy. Another example is provided by Phallika (2012) in the Trapaing Trabek irrigation scheme, where the proposal of the FWUC committee for the irrigation system extension (excavating Trapaing Veng reservoir) to be integrated into the communal planning was not approved by the commune chief. This further illustrates that FWUCs are effectively not independent.

While recognizing that the mixing of political figures (commune council members, village heads) and FWUCs can blur the distinction between the "state" and the non-state community based institution, Nang et al. (2011) believe that in the current situation, and considering that deference to political and administrative power is embedded in Cambodian society, this approach is valid for bolstering the otherwise weak authority of FWUCs. Their view appears to be supported by Phallika (2012), who deems that building relationships between FWUCs and commune chiefs is important, as it is the latter who determine the investments for socioeconomic growth in the area. These examples also suggest that in an attempt to introduce greater decentralization and deconcentration (D&D), the institutional structure introduced to give expression to these objectives have merely shifted the concentration of decision-making to a lower level of the political structure (i.e. the commune chief).

Lack of planning and coordination at scheme level

The Cambodian government's Technical Working Group on Agriculture and Water (TWGAW 2006a) ascribed the poor water management observed in many schemes to a lack of a proper operation plans for optimizing water allocation and ensuring O&M for timely delivery. In other cases, operation plans were available but were not used. In these cases, water was managed on a daily basis, with service quality differing from one user to another. This was not helped by the often absent tertiary canals, and the insufficient number of distribution structures (e.g. gates, stop logs and culverts). Consequently, the FWUCs were not involved in allocation, and there were few rules or regulations about water supply to rice fields, and where they did exist, farmers paid little attention to those rules (CDRI 2010). The result was two scales of local conflicts according to Chea et al. (2011): between neighboring farmers, and between farmers from the upper and lower regions of the same scheme. Coordination and collaboration between farmers was often inhibited as farmers who shared adjacent rice paddies often came from different villages and communes that were several kilometers apart. It was reported that this situation makes it difficult for farmers to develop camaraderie and mutual trust, and to amicably resolve issues about their rice paddies. In other cases, some farmers prevented other farmers, whose land was further away from the water, from having access to water by not allowing them to run a pipe through their land (CDRI 2010). The overall challenges of collective planning can be seen in the case of the Damnak Ampil irrigation scheme (Kampong Speu Province), where beneficiaries are from seven communes and information–sharing among them is difficult due to the geographic area involved, poor infrastructure and lack of financial resources to support all the FWUGs to come together for meetings (Nang et al. 2011). In the Kamping Puoy scheme, the FWUC has 64 members divided into 15 groups, each of which covers about 400 households. In addition to variations in conditions and needs, FWUC members must travel long distances to participate in regularly scheduled meetings and they were not compensated for their travel costs. Not surprisingly, CDRI (2010) found that, in Kamping Puoy, attendance has fallen in the face of farmer apathy and the lack of incentives to convene and attend meetings.

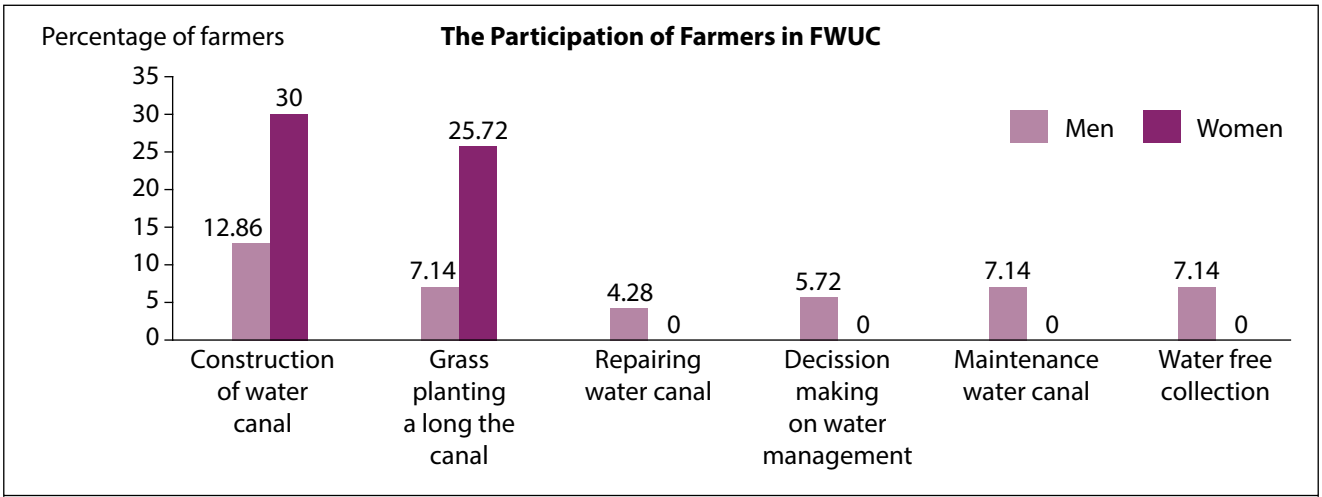
The level of complexity is increased when there are many kinds of local institutions with links to water use, such as the Stung Chinit irrigation scheme, which includes agricultural communities (e.g. Dry Season Rice Association) under PDAFF and the Village Development Communities under PDRD (Nang et al. 2011). While scale clearly provides a significant organizational challenge to FWUCs, small- and medium-scale irrigation systems may face limitations in economic efficiencies to meet export-oriented production (UNDP and Ministry of Environment 2011). In light of the government's emphasis on export of processed rice, this suggests the emergence of a paradox, where smaller schemes may be more manageable for FWUCs, but less effective in meeting national rice production targets. According to CDRI (2010), different schedules for water demand create a problem of coordination of rice planting, and this is more pronounced in larger schemes where the larger area tends to contain different soils that involve different rice varieties.

Many observers (CDRI 2008; Vuthy and Ra 2010) see this as a capacity issue due to a lack of training on irrigation infrastructure maintenance and lack of support from PDoWRAM. FWUC leaders and members are not equipped with enough technical training or financial capital to repair, develop and maintain infrastructure across the schemes, which in two out of three cases were greater than 100 ha. Investigations carried out by Chea et al. (2011) found that many FWUCs consisted of fewer than 10 people and, in practice, there were generally five or less active FWUC members. Although the PIMD policy paper requires FWUGs to support FWUCs in dealing with minor problems (i.e. individual rice fields and tertiary canals), FWUGs were often found to exist only in name and provided no coordinated function. Due to the large physical scale of schemes, some regions within the schemes were given little or no attention by the FWUCs, which was most notably so in the southwestern region of Rolous where farmers' trust in the FWUC's commitment to scheme management was consequently low. Although the low management capacity of FWUCs requires more assistance from PDoWRAM, this did not materialize, as PDoWRAM lack financial and technical capacity (Chem and Someth 2011). Nang et al. (2011) and Chea et al. (2011) recommend training programs for farmers that include water law, policy, and the FWUC statute and their related responsibilities, so that farmers can understand the responsibilities of, and tasks entrusted to, FWUCs. Such information is still not clear, even among the FWUC members.

The difficult economic conditions and the lack of financial compensation also undermine coordination activities. Nang et al. (2011) found that, due to difficulties in their living conditions and low levels of coordination among FWUGs and farmers, many established FWUG members. have given up their roles. According to Thuon et al. (2007), a similar situation appears to exist with the FWUC members. They noted that in Stung Chinit, the main office-holders of the FWUC were being paid a monthly allowance by donor-funded projects or the state and question whether the farmers would be able, or willing, to bear the cost of maintaining the FWUC committee after the withdrawal of the project.

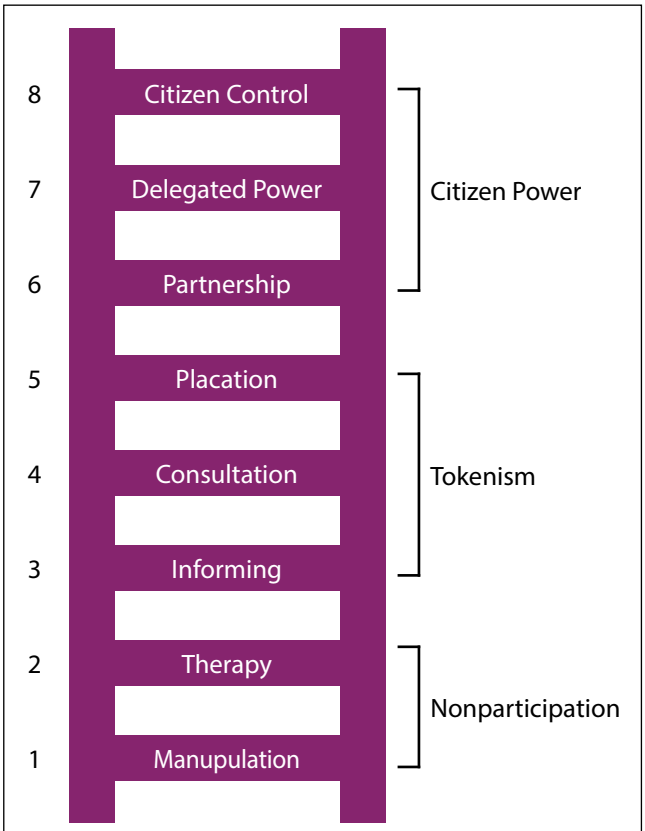
Underdeveloped participation and lack of ownership

The conceptualization of participation, by both policymakers and the participants, and the process of participation, influence how FWUCs function and discharge their planning and management responsibilities. The literature reviewed presents a consistent picture of relatively low levels of participation across the schemes covered by the various studies. 'Participation' here refers to both payment of ISF as well as involvement in decision-making about scheme management (e.g. O&M, water allocation), in terms of long-term planning or dealing with emergencies such as unexpected water scarcity. For instance, Phallika (2012) found that, in Trapaing Trabek, farmers only view and participate in FWUC meetings to know whether water will be available, and to make the FWUC aware of their problems related to irrigation, with the expectation that the FWUC will deal with these issues. Other forms of participation included payment of ISF, and providing labor and materials for secondary or tertiary canal O&M (Figure 5), while the idea of participating in making these decisions was not a common perception among farmers. This passive form of participation could be placed between rungs 3 (informing) and 4 (consultation) in Arnstein's ladder of citizen participation (Arnstein 1969) (Figure 6). Even this level of participation was found to be absent in some schemes such as Rolous, Stung Chinit and Damnak Ampil, where farmers lacked a sense of ownership and responsibility for the scheme's infrastructure, as they believed that it was the FWUC's role to attend to such tasks (Chea et al. 2011).



Source: Bunthan n.d.

Figure 5: Distribution of activities carried out by participating farmers in Roung FWUC (Kampong Speu Province)



Source: Arnstein 1969

Figure 6: Arnstein's ladder of citizen participation

In seeking reasons for this status quo, different perceptions of water, a lack of understanding of higher forms of participation and dominance of the FWUC, and other leaderships linked to strong cultural and historical norms, emerge frequently in the literature, often in mutual reinforcement. These operate together with discontentedness amongst farmers because they were not involved in the formation of the FWUC (Chea 2010), and/or the scheme has failed to live up to its expectations, reasonable or otherwise. Thus, many observers, including Chea et al. (2011) and Phallika (2012), found that ISF is difficult to collect, partly because water has been traditionally viewed as a free resource and farmers believe that what they are actually paying for is the maintenance of the associated infrastructure. An example of dominance by the FWUC Chairman is provided by Phallika (2012) in Trapaing Trabek, where a majority of farmers are members of the FWUC, but they only follow and accede to the ideas put forward by the FWUC committee and particularly the chairman. The chairman developed the management master plan for irrigation expansion without inputs from his fellow members of the FWUC, due, it is stated, to inadequate technical knowledge related to hydrology, irrigation management, environment, policy planning and financial management within the FWUC committee. A similar process was observed by Chea (2010) when the commune council called people from a private pumping station to discuss the irrigation water fees. Instead of having a discussion, the people present were told what the fees would be. Development decisions were generally made either by the commune, where the chief dominated, and the owner of the pumping station.

These observations suggest that institutions such as FWUCs and commune councils sanction the exercise of power by a single or a few individuals, rather than spreading the decision-making power across the community. The operation of traditional norms and attitudes towards leadership is an additional and powerful condition, which makes this possible. As explained by Chea (2010), the cultural understanding of participation in Cambodia lacks the core essence of the concept, as defined by scholars in community based natural resource management (CBNRM): "the coming together of local people to define priorities and develop rules and policies in the community, to implement rules and to enforce rules." Chea observes that the initiatives and the formation of the community structure, its rules and its policies were not done by local people, but by the government. She argues that the country is so tightly bound to its patron-client culture and all-pervasive notion of hierarchy, that the top-down nature in which the community approach has been implemented might be well-suited to the present context, where participation rarely exists beyond the nuclear family—as its people have not been empowered to exercise their rights and duties in a democratic system—and networking beyond the family and village is rare. Deference to political and administrative power is embedded in Cambodian society (CDRI 2008). Donor agencies advise that FWUC leaders should not already be established community leaders. There are merits in using established leaders (greater transparency and a system of checks and balances), but it may cause these new institutions to struggle to navigate existing loyalties to power structures (Chea et al. 2011). They cite the newly established FWUC in DAP in Pursat Province which has seven commune council members, one from each of the communes within the command area. The Pursat PDoWRAM justified this on the grounds that the CC representatives were well-known and popular, and had been good leaders and managers in the past. They owned rice fields in the command area and were well-off.

While the PIMD policy assumes that implementation would be democratic (i.e. the association's leaders would be decided on in an election), this was rarely realized. In fact, Molle (2005) asserts that these facts were not considered in adjusting policies and interventions to the Cambodian context. While participation in irrigation management implies that farmers should be involved in the process of designing policy, it is common for farmers and other stakeholders to work in hierarchical ways and rely on higher levels of government for direction (Nang et al. 2011). Observers (Perera 2006; Thuon et al. 2007; CDRI 2008; Chea et al. 2011), state that establishing FWUCs as local bodies governing irrigation marks a fundamental change in the way farmers go about their business, which needs to be borne in mind when making policy prescriptions. Compounding this, is the impact of several decades of civil wars and trauma on people's psyche, the fact that the country's adoption of democracy and decentralization is still recent and incomplete, and the governance structure is overridden by patrimonial political practices (Chea 2010). In particular, Chea et al. (2011) emphasize the bitter experience with the so-called participatory approach of the collective farming experiment of the Khmer Rouge, which remains at large in the memories of several generations of Cambodians. CDRI (2008) see the lack of cooperation among farmers as a reaction against the authoritarianism of the last three decades, and a widespread breakdown in trust. Perera (2006) emphasizes the need for extensive farmer mobilization to change the existing behavior of farmers into group action to fit in with the technical interventions of new irrigation designs.

According to Perera (2006), another factor affecting farmer participation is the renting of paddy lands by their owners. He cites the 5 February Irrigation Scheme where farmers who are involved in highland cultivation have rented out their land in the irrigation scheme. Although the FWUC constitution allows both landowners and tenants to be members, the tenants with an insecure claim to the land they cultivate are usually less willing to be involved in the FWUC and associated irrigation system management.

The issues discussed above contrast strongly with the theoretical and top-down approach adopted by the government and donors in developing the PIMD and D&D policies as part of an overall donor-funding package, with no involvement of local people (Nang et al. 2011). This constitutes the gap between a neat generic theory of PIMD and its implementation in the unique Cambodian rural context. Molle (2005) sees the motives for PIMD in Cambodia as another example of such policies serving state objectives (avoiding recurrent state expenditure and increasing rice production at national level) rather than a true commitment to addressing rural poverty. This is supported by Perera (2006), who found that FWUCs were left to work alone, with minimal or no support from local people or from the state.

Uncertainty and conflict over institutional roles

Chea (2010) points out that, uniquely, CBNRM and decentralized NRM have been running simultaneously in Cambodia's irrigation policy. While MoWRAM's national water policy delegates the management responsibilities of a specific irrigation system to the FWUC, represented by a locally elected committee, the nationwide decentralization policy (inaugurated in 2002) gives the newly autonomous elected local body, the commune council, the right to manage natural resources, including water, within the commune's territory. While it is generally recognized that councils will play a critical role in resource management, their powers and functions in relation to irrigation water management are broad and vague. Article 41 of the Law on the Administration and Management of Commune/Sangkat (2001) deems that commune councils "shall have roles to uphold and support good governance by using all available resources to address the basic needs of its commune/Sangkat to serve the common interests of citizens and respect the national in accordance with general policy of the State." The same law (Article 43) states that this should include promotion of social and economic development, upgrading of the living standards of the citizens, and protecting and preserving the environment and natural resources.[9] However, this falls short of specifying the kind of support that commune councils can provide to ensure that the creation of a FWUC responds to local community's needs, rather than simply being the wish of a line ministry (Chea 2010). The CDRI notes that the absence of a proper legal framework at the catchment level creates a barrier to effective stakeholder coordination (Tong et al. 2011). Three important sub-decrees, namely, those on FWUCs, river basin management, and water allocation and licensing remain in draft, making it difficult for agencies to implement their assigned duties within their areas of jurisdiction. The relationship between commune councils and FWUCs, and its mechanisms remains unclear. Despite appearing to enjoy an overlapping mandate over irrigation water with FWUCs, Chea (2010) finds that the vagueness of this mandate has prevented the councils from being fully involved in irrigation water governance, with very limited authority over either the farmers or the FWUC. In fact, Rusten et al. (2004) found that the councils are often at odds with the line department and the FWUC over water management decisions, due the operation of different allegiances between FWUCs and commune councils. In the former case, accountability is to the (farmer) community, while in the case of commune councils it is to a political party.

Another factor that appears to link FWUCs and commune councils is the annual development planning process adopted under the D&D programme, where village development priorities are merged into commune development priorities that are in turn combined into a District Priority Activity Matrix presented to the government, donors and NGOs to elicit their support at a district integration workshop. While such a process seems capable of attracting investments, discussions held with CC and FWUC members in Boeng Sne irrigation scheme (Prey Veng Province) (IWMI 2012) suggest that the process of identifying district-level priorities is ad hoc from a village or FWUC (i.e. bottom-up) perspective, given the uncertainty surrounding the selection of any single priority identified at village or commune levels. While this planning process is meant to facilitate bottom-up planning to reflect local needs, village-specific and even commune-specific priorities are not easily highlighted in the district workshop, since the selection of priorities first at commune level and then district level is based on their recurrence amongst the villages (at commune

level) and communes (at district level). The more villages that share a common priority, the more likely that it will be chosen as a commune priority, and the more communes that share the same or similar priority, the greater the chance of it being included as a priority for the district. It is, therefore, possible for a priority for one or a few villages or communes, to be lost at district level. For example, although the need for a high capacity pumping station is a common need amongst most communes in the Boeng Sne irrigation scheme, it may be overwhelmed by priorities of other communes and may be dropped as a district priority. Moreover, according to the commune council members interviewed, the process of setting commune priorities does not include farmers, as only village heads, CC members and government staff participate. None of the village heads and commune council members interviewed had attended a district integration workshop. The question then is how effective this development planning process is in meeting funding needs of specific FWUCs operating within a commune or across two or more communes. There seems to be significant uncertainty about the likelihood of being represented in the final list of priorities, and it is unclear as to how much of state and donor funds are channelled through this planning process, as opposed to being directly channelled through line ministries.

Nang et al. (2011) found that, at the national scale, the complex institutional set up also inhibits participatory decision-making that affects meaningful PIMD implementation. For instance, NCDD has members from many line ministries, except MoWRAM. NCDD tries to promote empowerment of local authorities and communities (encouraging more bottom-up decision-making), while MoWRAM creates the FWUCs in a top-down manner at the local level, following the PIMD policy, since they must be initiated and registered by MoWRAM.

Lack of planning and coordination at broader spatial/hydrological scales

The CDRI finds that increased competition over irrigation water between upstream and downstream communities during the dry season to be one of the most critical issues afflicting FWUC performance (Chem and Someth 2011). The CDRI observes a lack of coordination in the provision of water for multiple uses, including ecosystems (Chem et al. 2011). This is accompanied by a lack of hydrological information and knowledge that impedes water allocation, especially when dealing with multiple irrigation schemes. A greater understanding of spatial and temporal water flow is likely to improve catchment planning (Chem and Someth 2011). This is despite Article 8 of the Law on Water Resources Management of 2007 (the Water Law) requiring MoWRAM to maintain a centralized inventory of the water resources each year. Interviews with PDoWRAM staff in Battambang and Prey Veng provinces by IWMI (de Silva and Senaratna-Sellamuttu 2012) confirmed that decisions to rehabilitate existing irrigation systems are taken in isolation from systemic hydrological realities. Vuthy and Ra (2010) emphasize the almost total absence of groundwater data, and hence the inability to mitigate the impacts of droughts and other climate factors without degrading the resource base.

The need for a better planning structure is recognized by SAW, which calls for multi-stakeholder river basin plans, with the participation of the ministries of Agriculture, Forestry and Fisheries (MAFF), Rural Development (MRD), and Environment (MoE). The operation of jurisdictions of three separate ministries (MoWRAM, MoE and MAFF) in the management of water resources makes coordination imperative. Such coordination is, in fact, weak (CDRI 2008), since the vertical accountability of ministries and their line departments is so strong that it usually overrides the horizontal accountability of line departments at the provincial level.

The impact of insufficient hydrological data and institutional coordination on the ground is demonstrated by CDRI (Chem et al. 2011) in the Stung Chrey Bak catchment, where a contributing factor to water shortages was the lack of good coordination between upstream and downstream FWUCs in their water allocation decision-making. Nang et al. (2011) reported that farmers in this catchment thought that only PDoWRAM (or the LAs) had the right over the rivers in the catchment, whereas all three stakeholders have the responsibility for management of the rivers in the catchment. The coordination challenge is further complicated

when the same water source supplying multiple irrigation schemes flows across more than one province. This introduces inter-provincial dynamics, when farmers downstream in one province need water released from the upstream users in another province. The FWUCs plan cropping individually without consulting each other, contributing to dry-season shortages of water (Chem and Someth 2011). No formal institutional arrangements at catchment scale are in place for dealing with these complexities (Chea et al. 2011), and under the current arrangements, upstream irrigators have prior access to water, leaving downstream users at a significant disadvantage (Chem et al. 2011).

The Law on Water Resources Management (2007) remains largely confined to paper, especially with respect to the creation of basin/sub-basin level planning processes. This law empowers MoWRAM to declare any basin, sub-basin or aquifer as a Water Law Implementation Area, when there are likely to be conflicts among water users, the water may become polluted or the area may suffer watershed degradation (Article 5). It goes on to explicitly require the government to encourage collaboration with, and participation of, the relevant agencies, and private sector, beneficiary groups, NGOs, and international organizations in all activities related to the management, investment, exploitation, conservation and development of water resources (Article 7).

Production constraints

Cambodian farmers do not grow good quality produce, and affordable access to quality and reliable inputs is a major impediment to improving agricultural productivity and the quality of produce (RGC 2010a). The study found that there is inadequate importation of quality farm inputs, such as seed, fertilizer and pesticides, that comply with the Law on the Management of Quality and Safety of Products and Services (2000). In 2008, an increase in farm input prices have pushed up production costs by 30% for dry-season rice, 70% for wet-season rice, and 45% for maize, cassava, and soybean production (ADB 2012a). Moreover, Chea et al. (2011) found that even with the high yields that dry-season crops can produce, the fluctuating market price of rice relative to its production costs discourages farmers from growing a dry-season crop.

Fundamental constraints for smallholders imposed by uncertainty of tenure, farm size and trends in land markets

When considering agriculture from a poverty and food security perspective, in particular, land is a fundamental driver, in terms of: determining production performance and inequity. An analysis carried out by CDRI (Kimsun et al. 2011) indicates that many rural households in Cambodia suffer from landlessness or near landlessness, or lack of formal property rights to land, and see this as a major driver of widespread rural poverty and a limitation to agricultural productivity growth. Although there are no figures on how much of agricultural land is currently titled, an estimated 20% of rural Cambodians are thought to be landless and another 20-25% have less than 0.5 ha (the estimated threshold for food self-sufficiency). This suggests that (subject to renting arrangements) almost half (around 45%) of rural households cannot produce adequate food to meet their dietary requirements, let alone produce a surplus to sell (Diepart 2010) found this figure to be 65% in Trapeang Russei, Kampong Thom Province). In fact, while large farmers with 1 ha of land or more were able to increase their yields, small farmers with less than 1 ha and limited savings to meet rising costs of production, had declining or stagnant wet- and dry-season rice yields (CDRI 2012). Rising prices of farm inputs meant that land productivity of small landholders with less than 1 ha declined. Farmers claimed that the prices of farm inputs were double those of two or three years earlier. This constraint, combined with ineffective agricultural extension services, has limited the ability of small farmers to intensify and diversify their agricultural production.

This large landless/smallholder scenario is rooted in the evolution of land tenure systems over the past decades. All land was collectivized during the Khmer Rouge regime until its demise in 1979, after which the new government decided to establish collective property rights for land, to avert a possibility of widespread famine (Üllenberg 2009). When this failed, the free-market economy system was adopted in 1989 and private property rights were reintroduced. Lands were distributed to households based on family size and availability of cultivable land in the villages. In the distribution of land, local authorities played a significant role, as they had certain power to decide on the size, type and location of land to be given as well as to choose the recipients, based on the size of the family (Üllenberg 2009). While, on average, 1.37 ha were given to those families who applied, the size of the family determined the amount of land allocated. Consequently, single households got small land areas, which became insufficient as the family grew. While this approach may have seemed equitable, in principle at the time, it has initiated differences in landholdings and resulted in inequities that are visible today (Diepart 2010). For instance, the distribution of agricultural equipment and draught animals followed the same patterns as land redistribution, so that larger families received more land and more equipment (i.e. more productive capital). This has enabled these households to achieve a greater degree of household food security, compared to the continued food insecurity of many smallholders. Other forms of land acquisition by smallholders, such as forest clearance and land purchase was virtually closed off to them. Diepart (2010) found that permission had to be obtained from local authorities to get additional forestland, which involved financial contributions (making it virtually a land purchase) and strong connections with commune and/or district authorities. This, combined with the intense land speculation on state land by companies or individuals, facilitated the granting of rights to own state land as private property by actors in the local administration (commune, district and province) and largely excluded the peasant communities. Thus, local-level state agencies have become key actors in state land markets, giving rise to a structural land access problem for smallholders who still largely depend on agriculture for their livelihoods (Diepart 2010).

Diepart (2010) concludes that such a manifestation of the re-emergence of capitalism in the agrarian system generates the opposite results to those who want to introduce land reform within a free market mechanism. Under such reforms, land titling would increase land security for households who will use land as collateral to borrow money to improve land productivity. The land market will ensure the reallocation of land to those who are the most efficient in cultivating it, supposedly the household with the smaller landholding. It was further assumed that land-scarce households (i.e. smallholders) would be able to acquire land through the market since land-abundant households would sell excess land. In fact, the very opposite has been shown to be the case, where land sales are more frequent amongst land-scarce households (Diepart 2010) and large farmers and other external investors accumulate agricultural land.

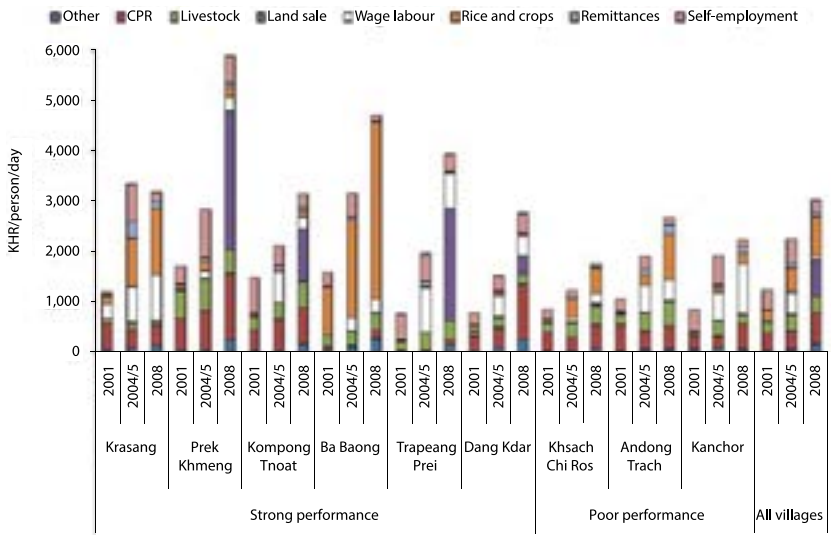
The emergence of land sales generally by smallholders, is likely to affect overall food production, smallholder food security and poverty reduction, and will influence the stated objectives of SAW and similar policies. Interestingly, Diepart (2010) found that, in Srayov and Trapeang Russei communes (Kampong Thom Province), 74% of land sale transactions are motivated by non-productive purposes (18% for health reasons, 46% for basic household expenditure and 10% to pay a debt), which can be seen as expressions of overall vulnerability. Although he finds that only 26% of land sales are motivated by the value of the land itself (to secure up-front capital to launch a non-farming activity), this may not be inconsistent with the hypothesis that this is a growing trend. Some support for this also emerged in Kamping Pouy irrigation scheme (Battambang Province), where some small farmers who viewed their plots as being unprofitable decided to sell them and join migration groups to other schemes or sought work across the border in Thailand and Vietnam (de Silva and Senaratna-Sellamuttu 2012). Underpinning this, was the rise in the per-hectare price, from US$ 10,000 to US$ 50,000, as larger investors sought control over more irrigated land. Further evidence of large price increases in irrigated land is provided by CDRI (2012), where the percentage change in price between 2004/2005 and 2008 (Table 4) is well over 100% in all but two of the study villages, with some values exceeding 1,000%.

	KHR 10, 000/ha			% change	
	2001	2004/5	2008	2001–4/5	2004/5–8
Krasang	227	360	1058	58	194
Andong Trach	203	96	403	-56	320
Trapeang Prei	84	234	4,588	178	1862
Khsach Chi Ros	41	58	142	43	143
Dang kdar	70	63	156	-11	149
Kompong Tnoat	328	688	3,855	110	460
Prek Khmeng	136	244	5,060	79	1976
Kanchor	191	272	205	42	-25
Ba Baong	194	240	375	24	57
All villages	167	263	1479	24	462
Source: CDR 2012.					

Table 4: Change in average real price of land per hectare by village, 2001-2008

This rapid rise in land sales as a significant contributor to income is clear from Figure 7, which shows the consistently rising percentage of per capita income from land sales between 2001 and 2008. By 2008, land sales appear to contribute as much as agriculture to per capita income. This has caused the number of landless households to accelerate between 2005 and 2008, and according to Üllenberg (2009), the Gini coefficient indicates an inequality of land distribution in rural areas of 0.66. It appears that the land market and resulting changes in landholdings are working contrary to the support small farmers need in government policy.

According to Diepart (2010), the only viable option for marginalized smallholders is the land rental markets which, contrary to the land purchase market, are less biased towards wealth and seem to offer a much more promising perspective for equal access to land (Figure 8). He finds that households with smaller landholdings relative to active labor tend to acquire land through land rental, and this is assisted by the practice of sharecropping in preference to cash rent.



Source: CDRI 2012

Figure 7: Real per capita income from different sources, 2001-2008 (KHR/person/day)

Source: Diepart 2010

Figure 8: Frequency of land leases (rent-in and rent-out)

The issue of land ownership has been further intensified by a rapid surge in population[10] growth in a context of limited agricultural land (about 2.8 million ha), of which 91% is devoted to rice cultivation and the remainder to other food and industrial crops (primarily rubber) (ADB 2010). Technically 80% of Cambodia's land area remains state-owned. In addition, a review of agricultural production by UNDP and the Ministry of Environment (2011) finds that gaining secure land tenure is the most important factor in improving agricultural yields. Moreover, Mund (2011) reports that, despite the emphasis placed by SAW on releasing more land for SLCs, and the intention to review the ELC system, the national agricultural land policy tends to promote the granting of large-scale economic concessions, rather than relying on sustainable innovations and improvements in smallholder farming systems.

From an overall rice production perspective, the tendency for the land market to create fewer larger farm plots may hold potential, since Diepart (2010), for instance, finds that it is the larger landowners who use their land as collateral to invest in productive technologies. This is also driven by a lower labor-to-land ratio compared to smallholders, who have more labor than an ability to borrow money for technology upgrades. However, this type of land accumulation of existing and utilized irrigated lands must be distinguished from the large tracts of state land that remain underutilized in the form of ELCs (Diepart 2010).

Poor quality seeds

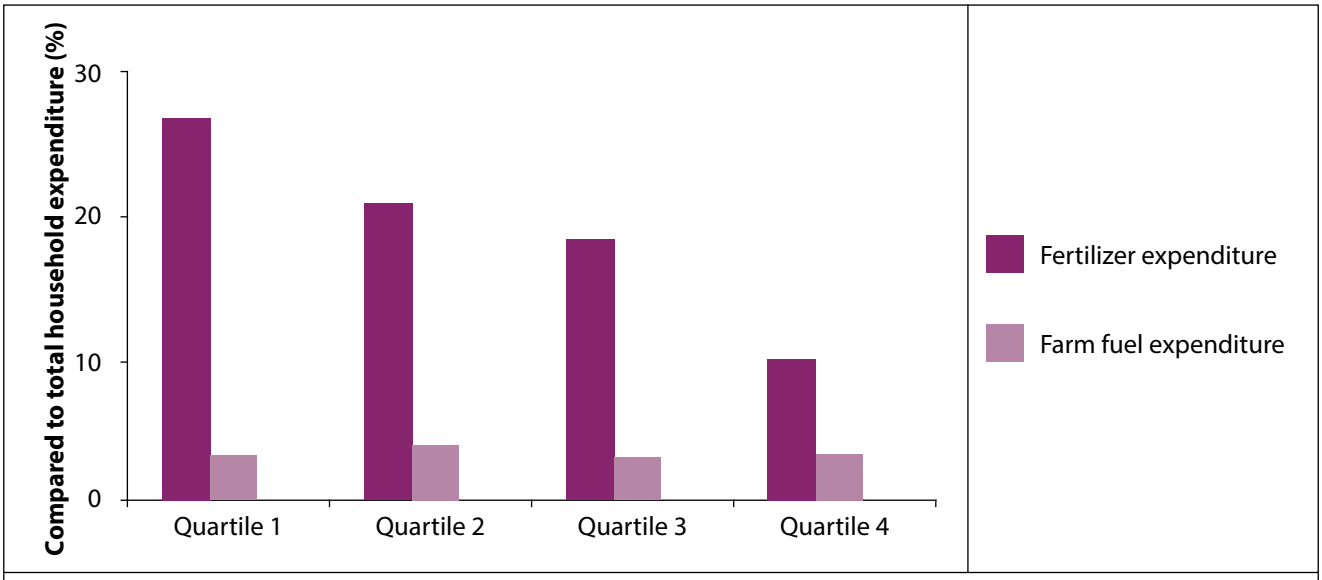
Sothath and Sophal (2010) believe that proper seed selection will help farmers to increase their rice yields by 18%, but notes that improved seed, fertilizers and tractors are still limited in supply in Cambodia. They cite statistics from the Super Seed Company of the Agriculture Quality Improvement Project (AQIP), a registered seed distribution company in Cambodia, which claims that sales of its seeds represent only 3–5% of the market share, with 10–20% of the market share being taken up by seeds from Vietnamese producers, and the balance being supplied by a few small domestic distributors and household seed banks from the previous harvest. This suggests, therefore, that there is significant potential for productivity improvements if investments were directed towards the importation of good quality seeds of the correct varieties, and enhancement of in-country seed production and markets that make these seeds accessible at affordable prices.

IWMI's dialogues with farmers in the Kamping Pouy and Boeng Sne irrigation schemes (de Silva and Senaratna-Sellamuttu 2012) suggest that the challenge is more complex than the procurement of good quality seeds. While there is no doubt that seed quality is important, the varieties used by farmers in both schemes was driven by the availability of a ready market (Vietnamese) and their ability to complete cropping cycles in the face of increasingly unreliable rainfall patterns. Seed varieties from Vietnam with short harvesting periods were thus preferred over the majority of varieties promoted by MAFF. This was also due to the knowledge of a ready market for a specific seed variety, which leant a higher degree of certainty to farmers' earnings. Therefore, while quality is necessary, irrespective of the variety, ensuring the adoption of rice varieties according to a specific government agenda is likely to be more challenging.

Fertilizer - lack of availability and poor quality

Chemical fertilizer use is extremely low despite native soils often being very infertile (ADB 2012a). The average amount of fertilizer used in Cambodia is below the national recommended rate, and is considered to be the lowest rate of fertilizer use for rice cultivation in Southeast Asia, with around 30% of the total area receiving minimal applications. On average, farmers applied 221 kg of fertilizer in Vietnam and 108 kg in Thailand, which both share similar soil and temperature conditions with Cambodia (ADB 2012a). Current fertilizer costs seem to be a major factor as shown in Figure 9, which suggests that this input alone accounts for about 20% of household expenditure, annually.[11] Yu and Diao (2010) confirm that higher fertilizer prices have prevented farmers from applying a sufficient amount of fertilizer to their crops. In addition to high prices, fertilizer use is also significantly affected by poor quality. Fertilizers and agrochemicals are imported informally across the border from Thailand and Vietnam, and sample testing has shown that fertilizers can be diluted by up to 48% (RGC 2010a). There are also no Khmer instructions on the label to ensure proper usage.

Yu and Fan (2009) found that land expansion, fertilizer use and irrigation are major determinants in the paddy-supply response, but with substantial differences in the production relationships across regions. They suggest, through simulated results, that when fertilizer prices increase, high output prices (such as those seen in 2007 and 2008) maintain the profitability of rice production due to the crop's high responsiveness to fertilizer application.



Source: NIS (2007); Mokoro (2010), Source: ADB 2012b

Figure 9: Household expenditure on fertilizer and fuel

Insufficient extension services

Agricultural extension services have limited coverage and do not serve the needs of subsistence and commercially oriented farmers. Diepart (2010) found that in both Srayov and Trapeang Russei communes, the state had completely withdrawn its support to farmers after the dismantling of the Krom Samaki system (Srayov commune). This seems to be the case nationwide (Table 5) where extension services provided by MAFF each year from 2002 to 2009 was limited to little more than 1% of farmers in the country. At the same time, there are no private sector technical or business development services available to commercial farmers (RGC 2010a). This lack of extension services may represent an unrealized gain in productivity of as much as 30% (and 40% in villages with irrigation systems),

	Units	2002	2003	2004	2005	2006	2007	2008	2009
Research									
New varieties developed					13(1999-2009)				
Cash crop varieties	no.				6(1999-2009)				
Soil, water, harvest packages	no.		2	4	4				
Leveling, tillage demos	no.		2	1	1				
Extension									
Farmers at training courses	'000	15.4	17.1	17.4	56.4	11.0	21.3	20.7	
Farmers at workshops/meetings	'000	2.5	1.5	6.0	24.1	6.5	8.1	4.4	
Farmers at field visits	'000	0.1	0.6	1.5	1.3	1.8	0.0	0.4	
Farmers at field school	'000	2.4	2.9	3.1	5.3		4.3	0.4	
Farmers at demonstrations	'000	1.1	1.0	1.1	0.9	4.7	0.5	0.6	
Farmers at demonstration days	'000	2.4	4.7	3.0	8.4	0.8	3.2	2.2	
Total farmers contacted	'000	23.9	27.8	32.1	96.4	24.7	37.5	28.7	20
as % of all farmers		0.9	1.1	1.2	3.6	0.9	1.4	1.0	
Irrigation									
New areas irrigated (DoP)	'000 ha	24.20	51.1	28	43.8	89.2	52.1	54.1	25
as % of all total irrigated area		3.8%	7.5%	4.1%	5.9%	10.6%	5.9%	5.8%	2.7%
Rural Roads									
Rehabilitation	km	107	349	256	277	204	262	585	43
as % of all total rural roads		0.4%	1.2%	90.0%	90.0%	70.0%	80.0%	1.8%	1.3%
No. of rehabilitated roads	no.	11	17	11	8	13	23	34	3
Periodic maintenance	km		297	999	609	0	353	510	50
as % of all total rural roads		0	1.0%	3.4%	2.0%	0	1.1%	1.6%	1.6%
Routine maintenance	km	82	159	124	241	334	384	535	59
as % of all total rural roads		0.3%	0.6%	0.4%	0.8%	1.1%	1.2%	1.7%	1.8%

DoP = Department of Planning, ha = hectare, km = kilometer.
Note: Blank spaces indicate data not available.
Sources: Cambodian Agricultural Research and Development Institute 10-year achievement report (1999–2009) and Annual Report (2003–2005), Department of Agriculture Extension Annual Reports, MOWRAM DoP records, and Cambodian Information System on Irrigation Systems, MRD Department of Rural Roadsrecords. Figures aim to include government- and donor-funded activities, but not communes, nongovernment organizations, political parties, or private sector. Cited in Mokoro (2010).
Source: ADB, 2012b

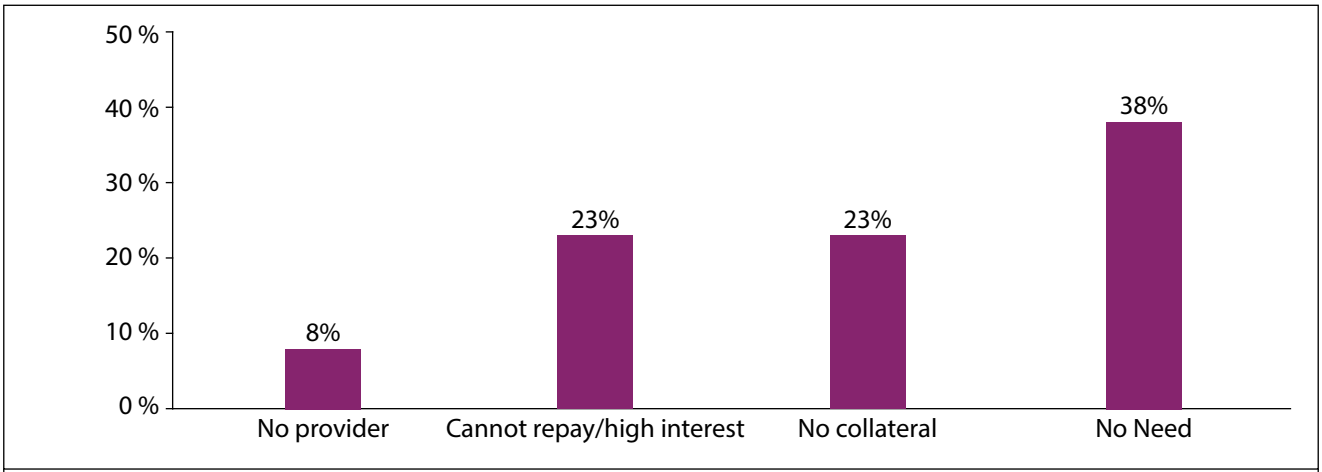
Table 5: Key outputs achieved in the Ministry of Agriculture, Forestry and Fisheries

according to Sothath and Sophal (2010). A further cost of poor extension services, as recognized by the government (RGC 2010a), is that primary producers are limited in their ability to diversify because they are unable to break into new crops or products because of donor and government programs, which only present information on how to produce more of the traditional crops. This is confirmed by CDRI (2012), which found that while some farmers had picked up new ideas on diversification from traders and neighbors, they have been less successful, owing to a lack of know-how and unreliable extension services.

Capacity amongst both MAFF and MoWRAM is a major constraint, with Lim (2006) noting that there are only 500 extension officers nationwide. SAW (RGC 2010a) recognizes that the capacities of the project management office (PMO) and project implementation unit (PIU) under PDoWRAMs are constrained by inadequate personnel. It also acknowledges that the remuneration of civil servants does not encourage self-development of staff or attract qualified and experienced personnel. Consequently, PDAs and PDoWRAMS do not have the capacity to deliver technical services required under the law to provincial councils.

Sothath and Sophal (2010) demonstrate structural constraints related to how technical staff are deployed within these agencies. They find that at the sub-national level, agricultural personnel are concentrated at the provincial level. In Takeo and Kandal provinces, they found nearly 70% of agricultural personnel were stationed at the provincial Department of Agriculture, with only 30% working in the districts and municipalities—and each of these extension workers were expected to provide support to as many as 5,000 farm households, on average. District Offices of Agriculture do not receive a budget from the government for executing activities, and are almost entirely reliant on assistance from donor projects and NGOs. Consequently, except for salaries, office supplies and support to purchase about 10 to 15 liters of gasoline per month, they do not have set budgets for field activities.[12] Furthermore, the authors conclude that extension services seem to be duplicated in the same districts and even at the village level. The lack of labor and other operational resources is magnified by the remoteness of many regions of the country making travel to remore communities time-consuming and expensive (CDRI 2010). Thus, assuming that PDAFF is operating with limited resources, they would tend to focus efforts on closer, easier-to-reach areas.

Two further related issues highlighted by Sothath and Sophal (2010) is the quality of the services that reach farmers, and farmers' capacity to assimilate this new information effectively into their farming. Dialogues held with farmers confirm that, despite attending extension courses, farmers have gained little understanding from these courses. Many of the farmers complained that the training was difficult to understand and suggested that trainers should provide clearer explanations, with experiments during the training and field demonstrations after the training. The farmers suggested that the courses should be provided to them every year, just before the start of the cropping season, so they could easily remember how to apply the information gained during training on their farms. This highlights the limited capacity of farmers, and the need for more extension agents at the village level. However, the fact that the extension services lacked experiments or field demonstrations suggests poor service delivery as well. The authors also find that adoption rates for new agricultural methods and techniques varied a lot from one village to another. On average, the adoption rate was about 6% , which is moderately higher than would be expected, although most were found to adopt only part of the extension advice and much of this service delivery was due to assistance from donors and NGOs.



Source: Lim 2006

Figure 10: Reasons for not taking formal credit

Costly credit and the resulting poverty trap

In terms of rural finance, there is very little long-term financing for investment capital available (RGC 2010a). The majority of loans from the formal sector require collateral, and in the informal sector, moneylenders charge high rates of interest that do not solve cash-flow problems in the long-term. Figure 10 shows that high interest rates and a lack of collateral account for almost half of the situations where credit was not availed of in the study conducted by Lim (2006). Given that the majority of financing is informal, Perera (2006) uses the Boeng Sne irrigation scheme to illustrate the poverty trap that most farmers are in. Due to the informal credit arrangements with the dealers, farmers are compelled to buy low-quality inputs at higher prices and input less than what is needed due to high prices. According to the credit arrangements, they are compelled to sell the produce to these dealers at a low price. Through this example, Perera (2006) also illustrates the corrosive influence of such credit arrangements on other critical farm inputs as well as the farmers' ability to obtain a fair, if not good, price. Üllenberg (2009) demonstrates that it is not only borrowings directly related to farming that impacts on a household's agricultural activities, by observing that while the poor are forced to borrow from private lenders at extremely high interest rates for a variety of reasons (e.g. to recover from floods and droughts, illness, etc. and some unrelated to agriculture), it is their agricultural land that may be sold to repay these debts as it is the only valuable asset they have. ADB (2008b) estimated that the unmet demand for rural credit was between US$ 50 million and US$ 100 million. Another report by ADB (2012b) points out that since farmers are forced to sell their produce as soon as possible post-harvest to avoid cumulative interest charges on borrowings, large volumes of paddy rice reach the market at the same time, bringing prices down, thereby further depressing the real value of their produce. Another CDRI report (Tong et al. 2011) found that households practicing double-cropping were strongly associated with higher borrowing, suggesting that high interest rates may also constrain intensification.

Although Phallika (2012) concludes that this situation has changed little in 2012, a different picture of the current credit situation is provided by CDRI. CDRI (2012) claims that since 2005, services from microfinance institutions (MFIs) have been increasingly available to farmers, as the proportion of panel households able to access credit from MFIs show an increasing trend, up to 57% of households in 2008, from 35% in 2004/2005 and only 19% in 2001, with the percentage borrowed for agriculture increasing from 18% in 2004/5 to 24% in 2008. The report states that MFIs, including ACLEDA Bank Plc, Amret, PRASAC, AMK and other NGOs, offer cheaper loan interest rates of 3% per month compared with 10–40% charged by private moneylenders, and that the number of licensed MFIs in Cambodia has increased rapidly between 2005 and 2008. It also states that loan portfolios have risen sharply, from a total of US$ 149,000 serving only 494,000 borrowers in 2005 to US$ 438,000 serving 1,020,000 in 2008 (CDRI 2012). However, the report acknowledges that the poor often lack the required collateral to obtain credit

from formal financial institutions, and that this limits their capacity to benefit from emerging economic opportunities generated by growth. In fact, poor households with limited capital for collateral find it difficult to obtain MFI loans, and their reliance on loans from relatives, friends and moneylenders remained higher than for the non-poor in 2008. The report further noted that many households, especially the poor, experienced a food deficit and took out loans for consumption purposes. In such cases, if their incomes did not improve, they then had to borrow more money from another MFI to repay their outstanding loans, thereby falling into a vicious cycle of debt and remained trapped in poverty. An analysis of the social and financial efficiencies of several MFIs by Crawford et al. (2011) provides a different picture. They too found an expansion of credit services, and that social and financial efficiency were not necessarily mutually exclusive, i.e., socially focussed MFIs do not necessarily sacrifice financial efficiency in order to maximize their outreach by serving additional poor people. However, their results show that this has only occurred in a few cases, and in others, the data show an increase in financial efficiency and a general decline in social efficiency since 2003. While they don't disregard more efficient functioning as one explanation for this, they suggest that declining social efficiency could result from what they call 'mission drift', where MFIs shift focus from the poor to more affluent clients. Data specific to the agriculture sector is provided by ADB (2012b), which shows that, as of 31 December 2009, only 12.95% of all bank credit was for agricultural loans (Table 6). The microfinance sector of the financial system is robust, having benefited from considerable donor investment and technical support. However, they have limited funds to lend, as they are mostly reliant on donor and social investment fund lines of credit and, hence, are already fully loaned up with the lowest risk loans. In his investigations in Kampong Thom Province, Diepart (2010) further enriches this picture in several ways. His finding that 63% of borrowings were from formal sources (banks or NGOs) supports the view that formal credit is more available today than half a decade ago. However, he notes that access to formal credit is spatially differentiated, depending on the proximity of households (and villages) to main transport routes. Consequently, informal credit sources with higher interest rates continue to be dominant in more remote areas.

Sector	December 2003		December 2004		December 2005		December 2006		December 2007		December 2008		December 2009	
		%		%		%		%		%		%		%
Agriculture	43,947	3.09	64,774	3.39	69,287	3.02	148,717	4.28	305,245	4.88	516,297	9.62	708,874	12.95
Manufacturing	187,563	13.2	269,187	14.08	11.29	258,756	410,579	11.82	625,585	9.99	983,664	18.32	920,411	16.82
Construction	83,154	5.85	97,972	5.12	144,957	6.32	269,067	7.75	640,685	10.24	773,808	14.41	904,485	16.52
Wholesale and retail	225,564	15.88	363,049	18.99	532,450	23.23	783,479	22.56	1,371,077	21.9	1,617,970	30.13	1,352,907	24.72
Export	117,471	8.27	77,615	4.06	37,507	1.64	26,209	0.75	13,728	0.22	…	…	…	…
Import	81,356	5.73	110,973	5.80	168,046	7.33	142,642	4.11	229,663	3.67	…	…	…	…
Finance	102,148	7.19	100,068	5.23	26,485	1.16	24,004	0.69	36,495	0.58	658,710	12.27	878,576	16.05
Real estate and public utilities	66,392	4.67	50,329	2.63	147,555	6.44	298,886	8.61	495,447	7.91	737,442	13.37	662,826	12.95
Services	478,440	33.68	675,634	35.33	667,473	29.12	1,146,160	33.01	1,802,350	28.79	…	…	…	…
Others	34,569	2.43	102,568	5.36	239,925	10.47	222,388	6.40	739,422	11.81	81,313	1.51	45,622	0.83
Total	1,420,604	100.00	1,912,169	100.00	2,292,442	100.00	3,472,130	100.00	6,259,697	100.00	5,369,204	100.00	5,473,701	100.00

… = data not available.
Source: NBC (2010).

Table 6: Lending by sector (2003–2009)

High exposure to risk and lack of crop insurance

Farmers' exposure to various agricultural risks is a concern in disaster-prone areas (Figure 11), and for farmers growing, or wanting to diversify into, crops with high sensitivity to weather variations. According to the World Food Programme (WFP) website,[13] damage to, or failure of, the rice crop is around 40% and the cost of such shocks or crises averaged 30% of total household annual cash income. RGC (2010a) recognizes the absence of any insurance against losses due to inclement weather or pests.

High energy costs which contribute to production costs

According to ADB (2012b), Cambodia imports all of its oil and only 25% of its population is connected to the electricity grid. Consequently, Cambodian farmers are largely dependent on diesel generators for household-operated water pumps and/or irrigation, and the rising cost of fuel has pushed up the costs of local and industrial transport and agricultural inputs such as fertilizer, which has increased in cost by three times in the past year (2011).

Lack of incentives to upgrade production

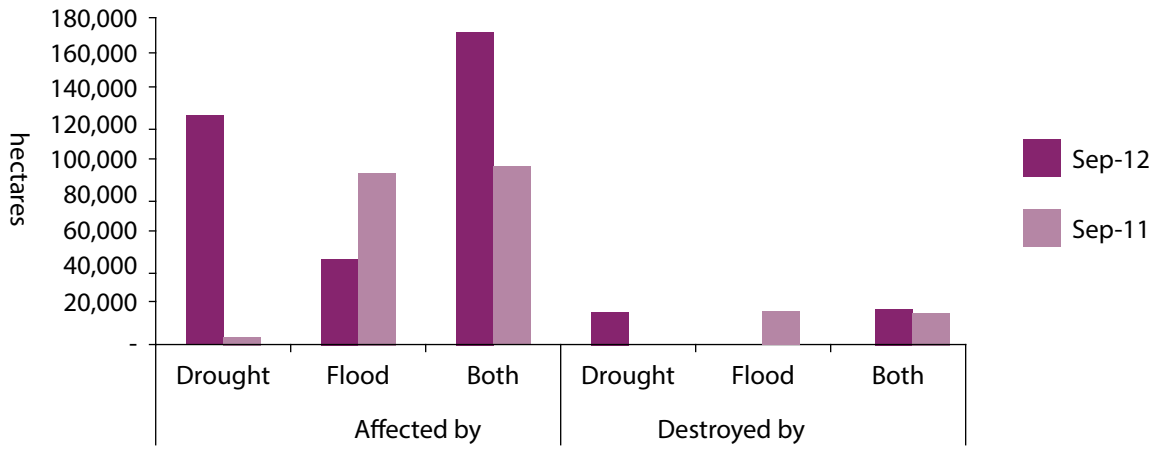
With little likelihood of seeing higher profit margins, there is little incentive for farmers to invest in better inputs, machinery or infrastructure. Income in the rural areas remains depressed in the face of poor output prices and rising production costs. While daily labor wages have nearly doubled in the last few years, they have only barely kept up with the increases in food and energy costs. Increases in agricultural input costs have not been matched with higher prices from sale of farmers' produce (RGC 2010a).

Lack of post-harvest services constrain realization of the potential value of produce

RGC (2010a) recognizes that farmers are not rewarded for their produce. While this is partly a result of poor quality inputs, it is also because, at present, farmers carry out very little post-harvest handling on their farms and are unfamiliar with modern retailing requirements. According to SAW, farmers are detached from their markets and unaware of consumer preferences due to the number of intermediaries, and support is required to develop and strengthen vertical value chain partnerships such as contract farming, between farmers and medium to large buyers. Thus, SAW foresees the establishment of commodity groups, through which commodity specific assistance can be channelled.

Lack of post-harvest technologies and facilities

According to ADB (2012b), post-harvest and milling losses in the Cambodian rice industry are high and variable. Most rural farmers are forced to sell their excess grains immediately after harvesting, as they lack the facilities and expertise for timely and efficient threshing, handling, drying, storage and processing of crops (this is in addition to the need to ease their debt burdens). Local estimates of grain losses, from harvest to storage, range from 20% to 50% , and are as high as 30% during milling. Farmers must sell whatever extra rice they produce immediately after harvesting because of poor and limited storage facilities.



Source: Ministry of Agriculture, Fforestry and Fisheries

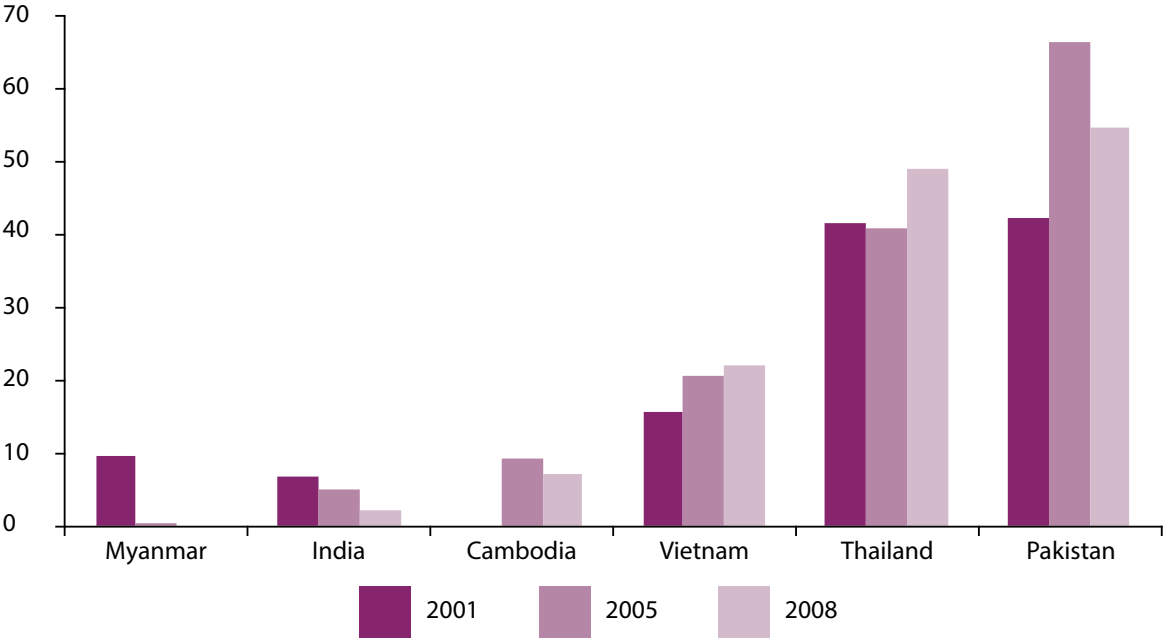
Figure 11: Areas under rice cultivation that are affected and destroyed as a result of natural disasters

At such time, given the oversupply of rice in the market, farmers have little bargaining power to negotiate the selling price. In addition, the quality of the rice has decreased, representing an added cost to farmers. However, as Phallika (2012) points out, addressing these weaknesses alone is unlikely to reduce the post-harvest market surplus of rice, given farmers' need to clear debts accumulated to facilitate production. These two issues, therefore, need to be addressed if the pressure on farmers to sell early is to be eased.

Markets and prices

With a population of just under 13.8 million, domestic food consumption requirements are around 1.97 million tons of rice, leaving about 3.5 million tons to export in paddy equivalent. These increasing domestic surpluses have led to robust growth of rice exports. Formal rice exports have been the fastest growing trade segment, expanding in value from US$ 7 million in 1998 to US$ 332 million in 2006 (World Bank 2010). However, a lack of processors and millers means that the vast majority of agricultural produce is exported in unprocessed form informally to Vietnam and Thailand through middlemen, and this prevents the country from capturing market opportunities for value-addition through rice milling. For example, it has been estimated that about 2 million tons of paddy were moved informally to Vietnam and Thailand in 2009, where it was milled and exported to international markets, including Cambodia (World Bank 2010). Rice millers have limited access to affordable credit and foreign markets, owing to their inability to produce consistent amounts of standardized varieties of milled rice and their lack of information about foreign market conditions (Sothath and Sophal 2010). According to a recent International Finance Corporation (IFC) survey, about 90% of agribusiness SMEs in Cambodia have identified the lack of access to finance as being their major constraint for growth (World Bank 2010). These sales to middlemen occur at a value lower than the market price, given farmers' dependence on this market. Thus, in Kampong Chhnang Province, a kilogram of rice was bought by middlemen for KHR 800 when the market price was KHR 1,200 per kg (Chea 2010). This represents a 33% loss of revenue per kg to farmers, though the reality is that this is preferable than being unable to sell all their produce in the local market, which cannot absorb such quantities. The report notes the need for a company or formal association in the community which can purchase their rice. In 2010, Cambodia's local middlemen could buy only 0.5 mt, while 3.8 mt of rice were exported to Thailand and Vietnam for further processing and packaging. According to some experts, Cambodia would need US$ 800 million to buy all paddy rice surpluses from local farmers (ADB 2012a). It is also suggested that the current uncertainty about the availability of markets may be causing farmers to wilfully maintain production at a relatively low level, pointing to a nationwide conscious underproduction due to market uncertainties.

As the government has duly noted, a real opportunity for value addition, at least from an export revenue perspective, lies in accessing export markets for milled rice. This has become especially attractive for the government, since rice production has reached a sustainable level of surplus within the last 5 years and has put increasing pressure on domestic markets. However, despite the government's efforts to encourage rice exports, the legal exports of milled rice have been minimal over the last 5 years (Figure 12), even though Cambodia has a competitive advantage in rice over other regional and international rice producers due to relatively low costs of labor and land (ADB 2012b). Reasons for the current status include: an internationally uncompetitive rice processing sector and the lack of good infrastructure (roads, ports and electrical power) in the country. There are also other transactions costs in Cambodia, such as illegal fees while transporting rice from farm to port. As already seen, this has encouraged the unofficial export of unprocessed rice to Vietnam and Thailand, preventing Cambodia from capturing the value added from rice milling (ADB 2012a).



Source: Authors' calculation from USDA Production, Supply and Distribution Online (2008).
Source: Yu and Diao 2010

Figure 12: Percentage of rice export in total production (2001–2008)

Insufficient value addition

Milling is the key bottleneck in the rice value chain in Cambodia (ADB 2012b). Although there are some 3,000 milling plants scattered across the country, nearly all of them are small-scale operations that rely on obsolete milling equipment, resulting in high levels of broken rice and other processing losses (Table 7). Lack of working capital and the high cost of credit constrain millers from upgrading their machinery and buying paddy rice from farmers. Concurrently, until recently, a handful of large-scale mills have started processing rice to a high level of quality that meets international standards and these mills now monopolize operations, allowing them to capture high margins. Thus, ADB (2012b) sees a need for increased competition in milling to help reduce milling margins that are substantially higher than those in Vietnam, and to raise prices to help the small-scale producers, in particular.

World Bank (2010) identifies limited access to finance as one of the main constraints for SMEs in Cambodia. It is estimated that, for domestic rice mills to purchase all current market surpluses of paddy in Cambodia (about 3.1 million tons), domestic financing of US$ 196 million would be needed. The working capital requirements to mill this amount of paddy would be about US$ 57 million, which means

Constraints	Nature of Constraints
Lack of working capital	Millers lack working capital to buy paddy at harvest time due to cash purchases of paddy and sales of milled rice on credit. As a result, rice mills are often idle for a period of time, limiting the amount of paddy that can be domestically milled. Limited capital also precludes improvements in milling technology and expansion in milling capacity.
Low paddy quality	Millers are constrained by poor paddy quality in the form of mixed variety of seeds from farmers and/or traders and inadequate postharvest handling (particularly drying). This results in high levels of broken rice that limits entry in world markets.
Low levels of milling technology	The majority of mills use old equipment from Vietnam and the People's Republic of China that are inadequate for sophisticated sorting of varieties and result in higher levels of broken rice than more modern machines.
Lack of market access	Rice millers have limited access to foreign markets due to the inability to produce consistent amounts of standardized varieties of milled rice. Market access is also compromised by limited information about foreign market conditions and competitive factors

Source: ADB 2012b

Table 7: Major constraints in the rice-milling sector

that total domestic financing requirements for the milling sector would be about US$ 253 million per year. Although the Cambodian government is looking for foreign investors to boost its rice-milling sector to increase production of milled rice for exports (RGC 2011), according to World Bank (2010), there seems to be sufficient capital available within the financial sector to fund investments in agriculture, agro-industry and SMEs, in general. However, lending for agriculture from domestic commercial banks was about US$ 130 million in 2008, which represents only about 5% of all lending, while lending to the agribusiness sector (classified as manufacturing) was about US$ 80–110 million (or about 3–4% of total lending). This amounts to only 1% of working capital and 1.7% of the investment capital financing needed by SMEs. Despite the high liquidity in the banking system, banks are reluctant to lend due to the following reasons: (i) low level of formalization of SMEs, which leads to lack of sufficient market credibility; (ii) institutional weaknesses, such as lack of proper record-keeping and accounting tools; (iii) absence of reliable credit information that increases banks' transactions costs in dealing with SMEs; and (iv) weak legal and regulatory framework that makes recovery of bad loans and contract ement difficult for creditors. This has made it difficult for lenders to assess risks versus returns properly, creating differences in the perceived versus real risk profiles and resulting in untapped lending opportunities to SMEs (World Bank 2010).

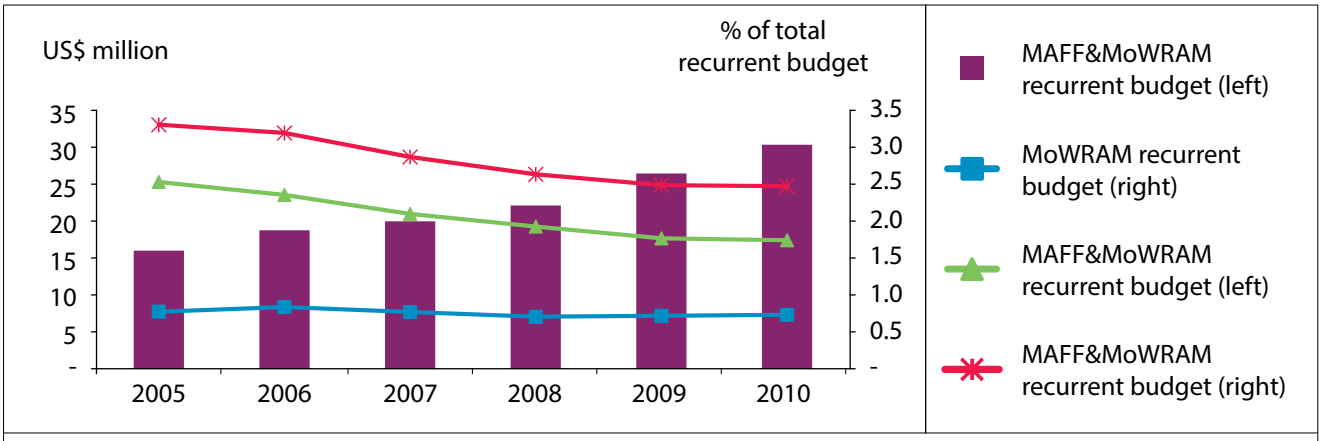
Underspending by the water and agriculture bureaucracies

Sothath and Sophal (2010) demonstrate that farmers are left underserved by public expenditure. Annual expenditure by MAFF and MoWRAM was about 4.8% (2% for MAFF) per year during 2006–2009, although both ministries were allocated a cumulative 7.5% (4% for MAFF) of the total budget per year over the same period. This means that the agriculture sector seriously suffered from a lack of expenditure to both ministries. ADB (2012b) further states that there is considerable expenditure volatility in terms of underspending (Figure 13).

Sothath and Sophal (2010) find that although the nominal recurrent budget for MAFF and MoWRAM has been increasing since 2005, its share of the total recurrent budget has declined over the same period (Figure 14). On average, the recurrent budget for MAFF and MoWRAM was about 2.7% from 2006 to 2010, responding to commitments in the NSDP, falling from 3.3% of the total recurrent budget in 2005 to only 2.5% in 2009 and 2010. This suggests that agriculture has been at a disadvantage

MAFF = Ministry of Agriculture, Forestry and Fisheries; MOWRAM = Ministry of Water Resources and Meteorology; MRD = Ministry of Rural Development.
Source: Ministry of Economy and Finance, Tables of Government Financial Operations (Mokoro 2010).
Source: ADB 2012b

Figure 13: Budget execution rates by ministry, 2000–2009 (%)

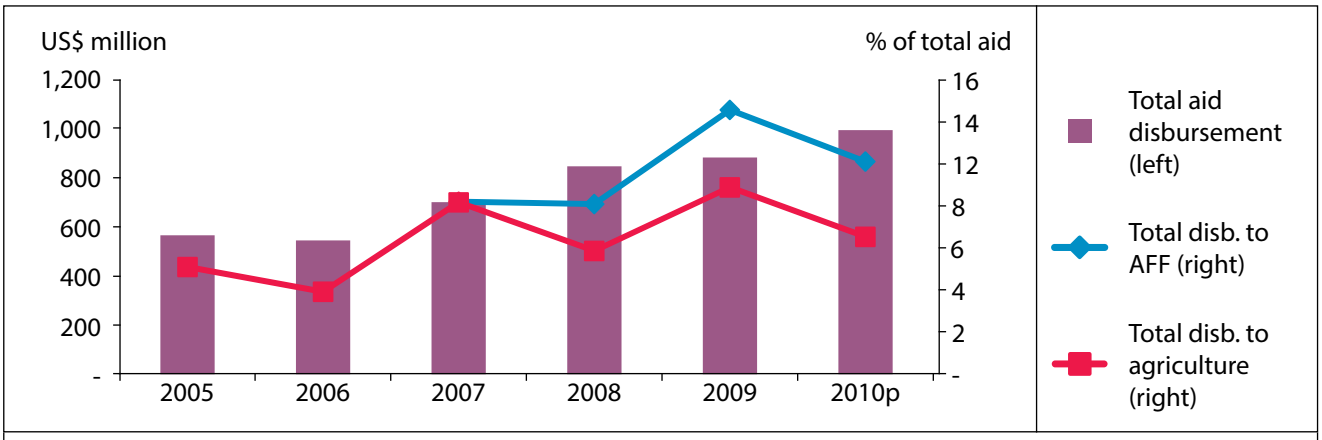


Source: National Budget Laws 2005-2010

Figure 14: Trends in recurrent budget allocation for MAFF and MoWRAM, 2005–2010

compared to other sectors in terms of the allocated budget, despite being recognized as a priority in the NSDP. Furthermore, the authors find that allocated resources are not necessarily spent as budgeted. On average, expenditure for MAFF and MoWRAM was less than 5% (4.8%) per year between 2006 and 2009, compared to its budget share of about 7.5% during the same period. This means that not all the allocated resources for MAFF and MoWRAM were spent.

Sothath and Sophal (2010) discover a similar pattern in the disbursement of foreign aid (Figure 15). The total aid disbursement to the agriculture sector was about US$ 211 million (or 7.7% of total aid disbursements to Cambodia) during 2007–2009. A closer look at aid disbursement for the agriculture subsectors and for program areas of SAW, 2006–2010, reveals that use of external assistance does not reflect the commitment of sector policies and strategies. Some subsectors and programs that are meant to benefit farmers tend to be largely underfunded (e.g. food security, and research and extension), whereas other subsectors or programs are overfunded. Also, subsectors and program areas of agriculture suffer from fluctuating aid disbursements, explained by the nature of donors' project-based support. The authors suggest that, while available resources appear to surpass the costings, underfunding for some subsectors is the result of poor coordination of, and command over, resources between different priorities. The allocation of aid to support food security, productivity and diversification during 2007–2009 represents only 25% of total agricultural aid, which is not even half of the commitments in the ASSDP (64%). Also, agricultural research and extension services received only 7% during the same period, compared to 11% committed in the ASSDP. While aid disbursement is not aligned with sector policy, the flow of disbursements by subsector has been unstable from year to year.



Note : : p = planned.
Source: : CDC/CRDB (2007) and CDC/CRDB ODA database.
Note: ODA = Official Development Assistance.

Figure 15: ODA disbursements to Cambodia (2005–2010)

The preceding sections indicate the significant impacts that some investments in irrigation have had on agricultural production, while also making it clear that irrigation is by no means a panacea for emancipating a large percentage of a predominantly rural population from poverty. This view also takes a direction from findings by CDRI (Wokker et al. 2011), which estimate that the extra yield produced as a result of irrigation, when measured in terms of rice production, is very low. This was particularly the case where a 1% increase in water use leads to a rise in rice yield of only 0.06% in the wet season, compared to 0.12% (i.e. double the increase) in the dry season. The CDRI also found that, for amounts of water larger than 1,000 m^3 per plot, and controlling other inputs (including land), very little is added to yield size. One interpretation of these findings may be that the yield increases of the past few years represent the difference between the availability and unavailability of irrigation water, and that some schemes are reaching the optimal point where further investments in irrigation may result in diminishing marginal returns, or larger gains require major investments in rehabilitating or upgrading infrastructure.

The most significant impact of irrigation has been that it enables dry-season production when cultivation is not generally feasible without irrigation. A CDRI study (Wokker et al. 2011) noted that 83% of farm plots that recorded any production in the dry season used irrigation. Where irrigation has worked, its value has not just been in terms of productivity, but also as a source of stability in the face of rainfall variability and other climatic changes—a role that is likely to become increasingly important. This includes providing supplementary irrigation even in the wet season in times of erratic rainfall, allowing farmers to complete the cultivation of two rice crops in the same season (de Silva and Senaratna-Sellamuttu 2012). However, UNDP and Ministry of Environment (2011) note that, while climate change adaptation recommendations for the country refer to the need for irrigation expansion, the case for irrigation is not clear-cut. The reasons are many, although one of the most fundamental appears to be the basic question of how much water is actually available or can be made available affordably, to underwrite future investments in irrigation. This applies not only to areas currently without irrigation, but to many existing schemes which exist in spite of poor water availability in a physical sense or due to uneconomical access. This has led CEDAC (2010) to conclude that most irrigation schemes have been found to be economically unviable. It has been further shown that this is not only due to water scarcity or other geographical factors, but because of poor scheme design and/or management (incomplete and/or poorly maintained infrastructure).

What should be the realistic role of irrigated agriculture in Cambodia?

The discussion of both current policy narratives on agriculture and irrigation, and field-based findings in the literature, suggest a significant divergence between what the policies envisage as being possible and the messages from the field. Although agriculture is certainly a key component of poverty reduction and export revenue earnings, there are multiple conditions necessary for irrigated agriculture (especially rice) to be viable, both economically and in terms of efficient resource allocation. This suggests a need to re-evaluate current policy within the contexts at play at smaller spatial scales (such as river basins/sub-basins) to ensure that future investments in irrigation are suited to contexts that make it physically and economically viable. For example, according to Yu and Fan (2009), improved access to roads can increase the output of wet-season paddy in the Tonle Sap, but has little impact on farmers in the Plateau/Mountain zone. However, in regions with high potential and reliable market access, policies promoting high-value crops could also substantially increase farmers' incomes and help lift them out of poverty. Similarly, a social assessment of selected irrigation schemes in six provinces around the Tonle Sap Lake found that farmers do not grow dry-season rice because of: insufficient water availability, location of irrigation schemes in lowland areas, the high cost of pumping water from the main canal to rice fields, poor water retention of sandy

soils, and the greater likelihood of the harm posed by insects and/or free-roaming livestock to dry-season rice (CDRI 2010). Thus, what is being recommended is the allocation of the investment portfolios available under SAW and other policies through a bottom-up assessment of area-specific opportunities.

In terms of the availability of water resources, such a strategic planning process will encounter a range of contexts that fall between two extremes: severe physical scarcity and an abundance of surface water for irrigation. Areas that have adequate water resources may still present logistical (cost) issues with respect to the conveyance of water from source to field, depending on its topography. Supplying irrigation water in such contexts may prove to be economically prohibitive, even assuming perfect production and post-harvest conditions (quality and affordable inputs, sound management, good prices, stable markets, etc.). However, others may be potentially profitable, if government leadership can alleviate the existing conditions that prevent farmers from increasing production efficiency and realizing the real value of their produce. This would mean making production affordable and productive, while facilitating stable markets offering good prices. The following discussion attempts to provide some perspectives on options for different scenarios.

Areas encountering physical water scarcity or prohibitive economic scarcity

The options are less clear in regions where irrigation is simply not possible, due to physical water scarcity or where providing irrigation from surface water sources is economically prohibitive, especially for rice production. As Perera (2006) points out, and is discussed elsewhere in this report, institution (i.e. FWUCs) building in irrigation schemes is not an easy task unless farmers believe that there will be definite improvements in irrigation services. Given the seemingly high percentage of schemes with fundamental design flaws, it is difficult to see how this is possible through the provision of more or better timed irrigation water, without leading to major infrastructure changes. Even such changes may not help schemes that are affected by physical water scarcity.

The efficiency-oriented response would be to promote less water-intensive crop options or even move completely out of agriculture. ADB (2011b) notes that activities such as vegetable and mushroom growing, pig fattening, chicken raising and fish farming are more profitable than traditional paddy production and have had high adoption rates. However, it also acknowledges that for most farmer households, these activities will be supplementary to paddy cultivation rather than substitutes for it. This is ascribed to household food security considerations and perceived risks associated with non-traditional agricultural activities (see also Tong et al. 2011). The challenge of displacing rice with more water-efficient alternatives, or displacing agriculture itself as the primary livelihood activity, is likely to be even more complex, given that paddy cultivation is deeply, historically, and culturally entrenched in Cambodia (as with most Asian people) not just as a staple food, but as an activity around which much of daily life and even value systems and beliefs are organized. Even if historical and cultural attachments were overcome, there would still need to be an effective national system of food distribution in place (if food production is to be concentrated where it is most economical) at prices lower than the costs of local production, to avoid food scarcity and/or malnutrition. The availability of alternate livelihood options will also have a significant bearing, irrespective of whether food security can be assured, given the diverse role of income in people's well-being. Migration may also become a coping strategy, but only for those able to provide labor elsewhere.

Another option that does not appear to have been considered in Cambodia so far is groundwater irrigation. Groundwater is widely used for domestic water supply in Cambodia, and is being increasingly used for small-scale irrigation. Small-scale pump irrigation from groundwater can avoid the need for the large investments in storage and transmission infrastructure required for surface water irrigation, while providing farmers with water in a timely and reliable manner.

Groundwater may present an opportunity for Cambodia to broaden its irrigation options by developing an efficient model of small-scale irrigation, instead of—or in conjunction with—formal surface-water irrigation that brings with it expensive infrastructure and problems of operation and maintenance. Or is it inherently unsustainable and suitable only for limited applications? The dearth of water resource data, especially with respect to groundwater, makes this an open question that needs further investigation (see Johnston 2013).

Areas which are potentially viable

The economic viability of providing irrigation water is influenced by the interplay between the costs of water supply, efficient production management and the opportunities for farmers to realize the full value of their crops. In many of the irrigation schemes cited as examples in this paper, a common issue was farmers' inability to optimize productivity due to poor input access and quality issues, and equally a lack of opportunities to get good prices for their produce, along with other issues surrounding storage and market uncertainty. In such schemes, considering the very low productivity returns of additional water use reported by CDRI (Wokker et al. 2011), it is argued that allocating more resources for addressing non-water constraints may offer more significant productivity and income gains compared to further investments in the irrigation schemes.

From the input side, some studies (Yu and Fan 2009; Sothath and Sophal 2010) suggest that the current scenario of underapplication and poor quality of fertilizer accounts for as much as a 30% loss in production, and when that is combined with irrigation, the gains can reach 40% (Sothath and Sophal 2010). However, the externalities associated with intensive fertilizer use can give rise to difficult trade-offs in terms of their impact on overall human well-being, and a resulting loss of ecosystem services such as fisheries. While specific estimates of value gains are not given, the discussion on post-harvest constraints illustrates the market-related factors that not only undermine farmers' income, but also appear to discourage them from maximizing production. This takes the form of choosing not to cultivate on all of the available land and refraining from investing in new hard and soft technologies (even when funds are available) where uncertainty is perceived in the market (e.g. low price, inability to absorb supply). These constraints are shaped by other weaknesses in the sector, such as the virtual absence of a post-harvest industry for value addition, causing surplus produce to be sold immediately upon harvesting—mainly through informal cross-border arrangements with Thai and Vietnamese traders and at lower than market prices. Investments in developing such capacities appear to hold significant value, assuming that Cambodia can become a competitive rice exporter in the region (i.e. Southeast Asia). Although recent studies suggest an expansion of formal credit services in the agriculture sector, there appears to be a considerable need for much larger flows of funding to underwrite the hardware investments needed for establishing storage and milling services. The mix of issues will vary in different regions and schemes, and the challenge for the government and donors is to ensure that their money is targeted at the best opportunities in each context.

Such a view appears to correlate with conclusions made by Sothath and Sophal (2010), who examined the allocation of ASSDP and SAW budgets across subsectors. Although they acknowledge that the policies target smallholder farmers by allocating larger proportions of their proposed budgets to areas such as: food security, productivity, diversification, research and extension, water resources, irrigation and land management, they found that significant resources have been diverted away from subsectors meant to benefit smallholder farmers in relation to the ASSDP costing. For instance, the share of disbursements to agricultural research and extension has not even been half of its costing. Under SAW, food security, agricultural and agribusiness support, and agriculture and water research, education and extension are underfunded, with a large share of resources being channelled to finance capital expenditure in water resources and irrigation. Similarly, during the period 2007–2009, aid disbursements to food security, productivity and diversification represented about 55% of total aid disbursed to agriculture, which is still below the costing level. The question is not whether irrigation schemes are necessary, but whether they are operational and effective (Sothath and Sophal 2010).

Interestingly, the same authors conclude that the policy formulation process does not seem to have been evidence-based, as there has been no comprehensive assessment of farmers' challenges and needs. This analysis argues that such attention to farmers' challenges needs to happen at subnational scales, and must seek to understand the variation in the combination of issues from one area to another. Diepart (2010) concludes that recent rural development policies offer a poor synthesis of peasant rationalities and only poorly capture the real dynamism of peasant communities. The peasant contribution to the development of the rural landscape has been largely underestimated. A market-based approach has been preferred, leaving these communities to bear the costs of transition to markets.

Two concerns about current policy and practice emerge. The first issue is the lack of depth in the problem analysis informing existing policies, which appear to prescribe blanket remedies across the country, which may lead to an inefficient allocation of funds in the form of inappropriately targeted interventions. This in turn poses questions about the policy-development process, particularly with respect to the extent of stakeholder consultations—the breadth of stakeholders and the geographical scales involved. The second issue concerns the allocation of resources, given the apparent deviation from stated budgetary divisions. Both of these issues are central to agricultural performance from a macro perspective, in terms of whom the proposed interventions will benefit, and who will bear the brunt of the resulting externalities.

The governance problem

Underpinning the discussions on improving the production process is the perennial issue of poor system maintenance and management. While exceptions exist, the majority of studies of FWUC performance suggest that the PIMD approach via FWUCs has been unable to generate the income necessary for maintaining existing and often incomplete infrastructure, or to provide the leadership in water governance to make irrigation efficient and equitable. These concerns, which result from problems with ISF collection, are closely associated with broader issues of FWUC operations and capabilities, and inherited fundamental design limitations.

The relationships between FWUCs, MoWRAM and the PDoWRAMs, have not supplied the technical backstopping necessary to support an experiment in participatory resource management in an extremely challenging context. Relationships with other key local players, such as commune councils, have added further layers of complexity that simultaneously seem to erode (overlapping functions) and support (merger of memberships) FWUC authority. Water governance manifests differently in various schemes, which further emphasizes the error in deriving policy on a generalized view of context (Chea et al. 2011). Cambodia's irrigation governance institutions are very recent and unstable, and the country has a long history of political disruption and internal migration which has prevented a synergy of its physical and socio-cultural topographies from developing. The success of the development philosophy of decentralization and deconcentration, and enhanced local participation in the rural Cambodian context, is inhibited by the historical experiences of the people and embedded cultural norms (Chea et al. 2011). These two problems have led to the manifestation of idealized theoretical governance policies at the policy level, whereby FWUCs have, to a large extent, become inefficient and dependent extensions of the line ministries, instead of independent and sustainable local governance bodies.

The current one-size-fits-all approach of FWUCs creates a fundamental constraint to irrigation water management and to agricultural production overall. The logical question is where and in which circumstances does the FWUC model work, and whether these conditions suggest opportunities for improving FWUCs elsewhere, or whether they are so context-specific that they hold little relevance in other settings. Where the latter is the case, other models will need to be found. In fact, the need for a divergence of institutional models may be driven by the need for more flexible approaches to irrigation, especially where the reservoir and canal systems are inherently inefficient and unsustainable. Any shift to other irrigation mechanisms (e.g. groundwater, surface water pumping, and conjunctive use of groundwater and surface water), would require local institutions that reflect different irrigation water management challenges.

The challenges of institutions also applies to the broader task of enhancing the overall value offered to farmers by agriculture, in light of the many production and post-harvest constraints detailed above. What is not clear is whether the investments in technological and technical capacity, and linkages required between various actors, can be generated through a single formal institutional arrangement, or through a combination of formal and less formal ones. However, several to address these problems are already in place.

Agricultural cooperatives

An alternative institutional mechanism currently gaining traction with both the government and donors is the agricultural cooperative (AC),[14] as a mechanism for empowering integrated self-development in the agriculture sector (de Silva and Senaratna-Sellamuttu 2012). Acknowledging that FWUCs are not empowered or able to influence a wide enough spectrum of production and post-harvest factors (e.g. access to inputs, post-harvest value addition), ACs appear to be a direct response by the government to these weaknesses. IWMI (de Silva and Senaratna-Sellamuttu 2012) notes several structural features that seek an institution with a greater ability to exercise control over factors of production and influence post-harvest processes towards better prices through value addition. For instance, the distribution of 60% of annual profits amongst AC members, based on shares held, provides an annual return on investment and could, at least in theory, provide the incentive for collective action that FWUCs appear unable to generate.

The cooperative model in theory appears to represent a more integrated approach to sector development, whereby existing isolated initiatives, such as savings groups and seed banks that often function only if external funds are available, can be brought into the cooperative and linked to other components of production. It is envisaged that this will also spark new ventures in seed production, drying and storage, and other business activities linked to the agriculture sector, making farmers less dependent on external actors. Examples are also appearing on the ground of attempts to realize this potential. For instance, according to Heifer Cambodia (2012), the Agricultural Cooperative of Ponleur Strey is helping start-up businesses in Dak So Sor Village, Battambang Province. The group plans to run businesses selling animal feed, fertilizer and horticulture equipment, as well as a rice bank for people in the community, and hopes to use its existing accumulated savings fund worth more than KHR 7 million (or US$ 1,750).

Another major advantage of ACs appears to be the economies of scale available through collective action, in terms of sourcing inputs at cheaper prices through bulk orders directly from manufacturers and negotiating market prices for produce on behalf of its members. In theory, at least, the logic and organizational structure of ACs is appealing in its potential to overcome some of the key weaknesses of farmer-based organizations. This belief seems to be reflected in the increasing number of cooperatives throughout the country, with an estimated 288 in various stages of registration and operation, and more being formed. Moreover, a number of donors are now promoting and supporting the formation of agricultural cooperatives and, consequently, they are now a reality to contend with. The potential for generating bottom-up sector development appears to make this an interesting experiment, but is an area which needs a detailed in-context study before the mistake of FWUC mass replication is repeated.

While FWUCs are the responsibility of MoWRAM and the PDoWRAMs, primary responsibility for agricultural cooperatives lies with the Department of Agricultural Extension (DAE) of MAFF, which includes an Office of Farmers' Organizations. The functions of this office include developing and maintaining government legislation for the formulation and registration of agricultural cooperatives in Cambodia; promoting and facilitating the formulation of agricultural cooperatives based on local needs and potential, by providing appropriate training and technical support to provincial and district extension staff in the relevant laws, regulations and administrative procedures; disseminating rules on ACs to farmers, NGOs, international organizations and potential donors; providing training courses to leaders and members of agricultural cooperatives; and conducting external audits to help ACs in financial management and bookkeeping (ICA ROAP 2007). These functions are carried out through the Provincial Office of Agriculture Extension (POAE) under the Provincial Department of Agriculture (PDA).

Private sector models for delivering agriculture services

A number of small-scale private enterprises provide a range of services for agriculture and other rural development needs. These enterprises and their customers have invested in a rapidly expanding market for water and other services, using a variety of financing arrangements with little external assistance from the public sector. They can leverage funds, offer good quality products and services, and maintain accountability for any issues that arise. This has led to high customer satisfaction and increasing sustainability (WSP 2004). The Farm Business Advisors (FBAs) created by iDE is an example of this. iDE trains independent private microentrepreneurs who provide high-quality agricultural products, technical advice and market information to smallholder farmers. FBAs travel within a six- to ten-village circuit helping farmers to improve, intensify or expand market-oriented agricultural production in Prey Veng, Svay Rieng, Siem Reap, Banteay Meanchey and Oddar Meanchey provinces, and plan to commence services in Kampot, Takeo and Kandal in 2013. FBAs analyze individual farm enterprises and match any constraints or missed opportunities they identify with the products and services in their 'toolkit', which includes irrigation equipment, good quality seeds, fertilizer, pest control, plastic mulch, plastic fencing and trellising (iDE 2009). FBAs sell products and services at a profit—often on credit with payment due at harvest—and provide technical advice as an embedded service. On average, each FBA serves about 90 clients and earns gross profits averaging US$ 53 per month, with highest earnings of US$ 105 (iDE 2010). Farmer clients are estimated to earn an additional net income averaging US$ 110 per year after receiving FBA support for one year, with strong evidence that female farmers have been able to access and benefit from the products and information provided by FBAs (iDE 2010). It is also claimed that FBA services have been reaching low-income households: based on standard government poverty classifications, 52% of FBA clients are either 'poor' or 'very poor' (iDE 2010).

The Cambodia Agricultural Value Chain Program (CAVAC) is a program which aims to increase farmer incomes in rice-based farming systems by accelerating growth in the value of agricultural production, through the linking of suppliers to farmers and farmers to consumers in Kampot, Takeo and Kampong Thom provinces. This approach tackles the following issue: rural areas are distant and disconnected, populations are spread out, infrastructure is poor, resources and information are scarce, particularly for poor farmers, both farmers and service providers struggle to reach each other, and transaction costs are high and efficiency is low. CAVAC identifies innovations that can overcome these inefficiencies, enabling farmers and public and private 'support providers' to access, communicate and engage with one another in new ways. These include: low-cost irrigation schemes managed locally, supporting progressive farmers to serve as change agents in their villages, encouraging input suppliers to use their retail networks to provide advice to farmers, as well as providing appropriate fertilizer and pesticides, and building networks between model farmers, government agencies and the private sector (Hitchins et al. 2012). The power to stimulate local entrepreneurship and the resulting creativity in resolving challenges demonstrated by these examples reveals the significant potential offered by small-scale private sector service delivery models in overcoming a range of current constraints. They suggest a need to recognize the comparative advantages and limitations of what public institutions and private market systems can deliver, so that the best of both sets of actors can be used in a more coordinated manner in delivering the services needed, especially by smallholder farmers. In view of the thin spread of PDoWRAM and PDA capacities, one option would be to use private actors to deliver information and hard and soft technologies to the end-users, while the state (at national, provincial and district levels) facilitates and regulates (e.g. setting and ing quality standards for seeds and other inputs) the generation/access of information, knowledge and technologies. The impact such a network of service providers could have on the viability of FWUCs is unclear, although CAVAC is currently experimenting with such linkages (Phallika, personal communication).[15]

Agriculture for poverty reduction or agriculture for export? An emerging policy dilemma?

A government is required to address developmental challenges at different scales. In Cambodia's case, the government has set out to concurrently address rural poverty and increase government foreign exchange revenue through increased rice production and export. Poverty reduction is both noble and necessary, while expanding government revenue sources can be diverted to other forms of public expenditure with social benefits. The problem arises in attempting to achieve these objectives through agriculture, and rice production, as each objective requires the promotion of different and mutually exclusive production models. In the case of poverty reduction, the approach must respect the reality of many distributed small landholdings, which in many cases, represent one amongst a suite of livelihood activities that collectively form household livelihood systems. On the other hand, maximizing rice (and other crop) production for export calls for intensification in search of the economies of scale that will generate efficiency and the desired surpluses, once domestic demand is satisfied. Not only will this concentrate agricultural land in few hands, but these hands are unlikely to belong to smallholders who, as has been amply demonstrated, do not have the financial and associated capital necessary for this scale of production. This is then the policy dilemma inherent in current policies such as SAW. The *Policy Document on Promotion of Paddy Production and Export of Milled Rice* (RGC 2004) operates against the interests of smallholders, by focusing on production volumes and efficiencies in production, at the expense of smallholder farmers, many of whom are unable to contribute to this objective.

While it is clear that the opening of export markets and investments in milling and other value-adding capacities will benefit smallholders, the issue is fundamentally driven by the implications for landownership in a national context, where access to land remains the primary productive asset for a majority of Cambodians. Intensification that involves larger production units can involve several other land-use trade-offs detrimental to smallholder households, which are linked to their multi-resource dependant livelihood strategies. The importance of this multi-activity livelihood strategy becomes apparent given that, according to the World Food Programme website,[16] in a bad year only the better-off farmers can sell some rice, while the middle and poor households consume all their harvest and store the rest for seed. Even within large rice-producing provinces, 30% of communes face chronic food shortages, and an estimated one in five rural inhabitants is unable to secure enough food to meet the nutritional norm of 2,100 calories per day and, as a consequence, malnutrition is widespread. While agriculture is the mainstay of these livelihood systems, it is by no means adequate to meet a household's food and nutritional requirements, and does not provide the opportunity to earn an income. In such cases, other livelihood activities, including access to other land uses and ecosystem services, may be more relevant.

Loosing fish to grow rice

As noted by MRC (2008), the significance of rice-field fisheries for Cambodia's population lies not only in their yield and contribution to nutrition, but in the dispersal of benefits through the population, particularly to the rural poor—many of whom are landless and have limited opportunities for employment. The traditional farming system uses comparatively low inputs of chemical fertilizers and pesticides, and involves prolonged inundation of fields. This allows a diverse native aquatic fauna to persist, which forms the basis of an important fishery. Nguyen-Khoa et al. (2005) warn that a reduction in rice field water storage with irrigation, increased use of agrochemicals and barriers to fish migration created by irrigation infrastructure could threaten fisheries production. They point out that agricultural productivity gains from such practices would need to offset the concomitant loss of fisheries, in order to be beneficial in aggregate terms. Based on surveys in 2004, MRC (2008) states that these losses (in monetary terms) come close to matching the then value of agriculture, where smallholder farmers earned about US$ 150/ha, on average, as a gross income from wet-season rain-fed rice farming, while the fishery was worth about US$ 102/ha as a gross value. According to Thuon et al. (2007), if wild capture fisheries are affected by agricultural

intensification, attempts to compensate by developing aquaculture face not only impediments related to landholding size and location as discussed below, but may tend to shift the workload onto women and children.

A weakness in the common-property nature of the rice field fishery, however, is that since each farmer cannot control access to this resource (landholdings are generally small, often fragmented, and distant from their owners' houses), none would have a direct incentive to conserve the fishery or to invest in simple measures such as trap ponds that would greatly increase fish production and capture efficiency (MRC 2008). Nevertheless, the rice-field fishery is accessed by most rural people during some part of the year.

A counter-argument to the loss of rice-field fisheries is that the creation of reservoirs provides an alternate fishery. IWMI's focus group discussions with fisheries committee members from the Kamping Pouy and Boeng Sne irrigation schemes (de Silva and Senaratna-Sellamuttu 2012), indicate that the reservoir fisheries in both schemes have declined significantly due to resource governance challenges, resulting from a relatively large area that poses rule ement challenges and the task of coordinating management amongst several fisheries committees spread across multiple communes. MRC (2008) recognizes that the value of pest control for indigenous carnivorous air-breathing blackfish and naturally occurring predators, such as frogs and toads, has never been scientifically evaluated. Unlike the introduced species (e.g. common carp, Nile tilapia and silver barb), which are commonly used in rice-fish culture, native species can move freely through rice fields, as they are essentially amphibious and do not require oxygenated water to survive. These indigenous fish do not require the same level of management as introduced fish, which cannot tolerate deoxygenation and usually require that some rice-growing area is sacrificed to make refuges for them. Furthermore, when rice plants are actively growing, shading virtually eliminates other saprophytes and plankton, forcing the introduced fish to feed on poor-quality detritus. This does not apply to indigenous fish that have coevolved in traditionally managed rice fields. Carnivorous fish are generally better food fish, preferred by villagers, and they fetch a higher price than omnivorous or herbivorous fish. Another important consideration is that fish from rice fields may well constitute a household's primary and most affordable source of animal protein, and definitely represent far greater nutritional values than rice. The trade-off in nutritional terms is likely to be significantly detrimental. Thus, considering these factors integrating the rice-field fishery with agricultural development should be carefully considered, since further intensification to a double-cropping rice system can be expected to create conditions that are less favorable for many aquatic organisms (MRC 2008). In the Stung Chinit irrigation scheme, for instance, even though a fishery survey in 2003–2004 identified 79 species, only 53 species were found after the construction of the scheme and despite the operation of a fish ladder (Thuon n.d.). Moreover, most of the fish that migrate through the fish ladder are small and can only be used to make fish sauce, food for pigs, or used as fertilizer with low economic value. Also, dry-season water levels did not permit fish to migrate through the fish pass.

Agrochemical intensification and impacts of freshwater production systems

While the impacts of intensification of fertilizer and other agrochemical use on groundwater is not well understood, greater certainty may be ascribed to its impacts on surface water ecosystems, including fisheries and rice-fish systems, both of which lie well within rural smallholder livelihood systems. The return of water used for irrigation to its source means that the impacts of chemical use will not be restricted to the people who use it, or to localized ecosystems. Thus, the potential for damaging key natural resources that underpin a range of rural livelihoods across a large population is high.

Impediments to livestock

According to Thuon et al. (2007), the construction of irrigation infrastructure can create more problems for rural livelihoods than before and illustrates this through the impacts of cattle rearing, which is one of the major income generation activities, apart from paddy cultivation. Farmers who live within irrigated areas have been forced to sell some of their livestock due to the many rules related to

unlined canal maintenance, and the reduction of grazing land within the scheme. This is because, prior to existence of the scheme, livestock were allowed to freely roam in the fields after the rice harvest. The propensity for conflict between these two land uses is illustrated by the fact that CDRI (2010) presents the issue from the opposite perspective, noting that in several schemes, animal raising and grazing practices make it very difficult for farmers to move into dry-season farming, as it is customary for households that own livestock to herd them in open paddy areas during the dry season.

Loss of forests

There is no question that intensification and expansion of agriculture for export will require the conversion of more forestland, to make way for large agriculture operations or to provide land for smallholders displaced from irrigation schemes and other cultivation areas. Loss of forests means loss of a diverse range of free resources for the poor. In addition to loss of forests due to ELCs is its illegal conversion, often by outsiders, to grow cash crops such as cassava, soybeans and maize. CDRI (2012) note the prevalence of such conversions prior to elections, and cite the massive legal and illegal conversion of forestland and flooded forests for cultivation during the run-up to the 2008 elections.

The range of trade-offs between agriculture and other forms of productive land uses, as described in the preceding paragraphs, and which are likely to be borne by smallholder farmers, demonstrates the need for a holistic evaluation of the merits of changes to farming systems based on assessments of their overall socioeconomic effects, particularly on the more vulnerable segments of the population (Thuon et al. 2007). The same authors further suggest that most proposals for large-scale irrigation schemes in Cambodia underestimate the impacts of such schemes on natural products, and overlook the livelihood and social activities that are dependent upon natural capital, such as wetland habitats, which are lost during the development of irrigation schemes.

Sothath and Sophal (2010) demonstrate the discrepancy between policy statements prioritizing the role of smallholders in alleviating rural poverty and the allocation of state resources (MAFF and MoWRAM) and foreign aid flows away from smallholders. These authors and others have confirmed the continued issuance of economic land concessions, despite policy recognizing the need for their review. Such inconsistencies suggest an ascendancy of agricultural intensification which appears to be facilitated by what seems to be an increasing trend of smallholder exit from irrigation schemes, allowing for land concentration amongst a fewer larger landowners due to liberalization of the land market.

CONCLUSIONS

This review has attempted to use on-the-ground findings and the opinions of a diverse range of observers to critically assess the implications of agriculture and associated policy on the specific realities of smallholder farmers. In doing so, the analysis is biased towards the socioeconomic implications for a group of vulnerable people (poor smallholders farmers) who are of interest under the Millennium Development Goals.

The results of the analysis suggest a fundamental gulf between problem statements and prescriptions within the ASSDP and SAW, and the spatial variation in the mix of factors affecting agricultural production and the effectiveness of irrigation, as well as the ability of poor smallholder farmers to produce more food more affordably. With respect to the policy of PIMD, the conclusions of Perera (2006) continue to hold true today. Implementation of PIMD in Cambodia under existing unfavorable conditions, including high levels of poverty, low agricultural productivity and deteriorated irrigation systems with frequently poor design, is a difficult and challenging task (Perera 2006). In many irrigation schemes, the current PIMD does not encourage farmers to fully participate in paying irrigation service fees, O&M of the scheme or in water management, and this is unlikely to change, especially in schemes afflicted by physical (surface) water scarcity and/or significant economic scarcity. In other areas, the identification of a wide range of structural constraints suggests scope for improving the efficiency and value of agriculture. Much of this potential lies in investments other than irrigation, although access to water, through surface irrigation or from groundwater, will remain a basic determinant of production. Different studies suggest different factors that promise high returns on investment. These include accessibility and intensification of better quality fertilizer and seeds, and promotion of small- and medium-scale industries to enable crop storage and value addition. In such cases, the performance of those schemes will probably improve, although it is unlikely to completely solve the ISF challenge, causing system performance to remain suboptimal.

Addressing this will require the government to weigh the opportunity costs of further continuous and large investments in infrastructure rehabilitation, in light of the marginal returns on additional water in some schemes. Large irrigation projects have been less relevant, are likely to be considered less effective and efficient and are likely to be sustainable only if special inputs are provided (ADB 2010). The scope for identifying conventional large irrigation projects is limited in light of the low level of past successes and range of problems, and call for more innovative approaches such as smaller scale simple water resources management projects that are easier to implement under the evolving institutional capacity of the country. Such recommendations resonate with this review, which finds an insufficient level of subnational planning; the lack of coordination amongst irrigation schemes sharing the same water source; single-sector oriented and ad hoc planning; and the absence of hydrological data to provide a realistic planning context. Integration is required, where all CBNRM committees and state authorities in a catchment need to have a mechanism to work together and focus on horizontal accountability or coordination mechanisms (Chea 2010).

These facts should then mitigate the urge on the part of the state to throw more money at a one-size-fits-all approach to irrigation, simply on the basis that the lack of a secure water supply restricts producers to a single, rain-fed rice crop per year, discouraging the diversification of local farming systems. Making such investments and then expecting the beneficiaries to realize returns is clearly contradictory in light of the diverse constraints highlighted in the literature. It is assumed that the motivation for the current emphasis on irrigation infrastructure is efficiency in resource allocation, and rehabilitation has not become an entrenched self-serving strategy for the bureaucracy.

The findings on FWUCs suggest that more flexibility is necessary in envisaging local irrigation management institutions, especially if groundwater use for agriculture continues to grow. While the literature provides good analyses of why many FWUCs are struggling, there needs to be an examination of where they do work well and the potential for improving other FWUCs. Such improvements will be possible in limited contexts—we need to think beyond the FWUC model for institutional options for irrigation management. This could involve nurturing of the various small-scale private sector initiatives that appear to deliver services more efficiently and effectively, especially to the smaller end-users. Supporting and using linkages amongst a growing number of non-state actors can be a win-win strategy for the government to better focus the scant and sectorally alienated resources at provincial and district levels.

This review also sheds light on the practical incompatibility of simultaneously pursuing agriculture-driven rural poverty reduction, whilst also seeking to maximize agriculture exports, especially rice. This dichotomy lies in the need for opposing systems of production, which hold significantly different implications for the poor smallholder farmer. Adoption of a more spatially differentiated investment strategy, as already suggested, may offer opportunities for a compromise whereby a balance can be achieved between intensified large-scale production for export and targeted investments to alleviate at least some of the constraints that prevent the rural poor from moving out of poverty.

NOTES

[1] Launched in 2004, and updated in 2008 as Phase II.

[2] A household can receive up to 5 ha of land, according to the Sub-decree on Social Land Concessions (Üllenberg, 2009).

[3] After five years of occupation, the land recipient would then be eligible to apply for landownership title.

[4] Smallholders in Cambodia have farms less than 3 ha in area. According to this definition, 94.3 percent of farms in Cambodia are small and this is based on a survey carried out by Agri-Business Institute Cambodia (ABIC) in 2005 (Sothath and Sophal 2010).

[5] No. 146 ANK/BK

[6] Irrigation Development in Cambodia in 2011
Source: http://trustbuilding.wordpress.com/2011/04/27/irrigation-development-in-cambodia-in-2011/

[7] The FWUCs were classified into three categories: those functioning well, defined as being active with O&M, regular meetings and irrigation service fee collection; those that could function where there was some activity in O&M; and those that did not function at all.

[8] To be formally and legally recognized, each FWUC (along with its governing statutes) must be registered with the provincial or municipal directorate of MoWRAM.

[9] Interestingly, Article 45 of the same law excludes forestry from the purview of commune councils.

[10] From 9.532 million in 1990 to 14.138 million by 2010 (a rise of 67% over two dacades) according to the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision: http://esa.un.org/unpd/wpp/Excel-Data/population.htm

[11] The Cambodian government provided subsidized fertilizer in the 1980s and 1990s until the private sector came into the fertilizer market in 1997, at which time the government stopped providing the subsidy.

[12] Despite these findings, the authors conclude that the coverage of agricultural services for smallholder farmers is quite wide in the districts of Takeo and one district of Kandal, and that the percentage of villages with access to services in these districts ranges from 70 to 100 percent. This is a surprising conclusion in light of the significant paucity of human and other resources they document, although it can be seen to illustrate a variation between districts.

[13] http://www.foodsecurityatlas.org/khm/country/access/livelihoods

[14] Agricultural cooperatives are not new to Cambodia, with 390 multipurpose agricultural cooperatives existing in the 1950s and 1960s. However, under the regime of Democratic Kampuchea (1975–1979), all cooperatives were transformed into "Popular Communes" that operated on a collectivized basis to further the sociopolitical objectives of the government. After 1979, the collective cooperatives were again transformed into "Solidarity Groups" for collective production using the limited resources left after the Khmer Rouge regime, but these were mostly inactive. Government support for cooperatives reappeared in 2001, with the Royal Decree on Establishment and Functioning of Agricultural Cooperatives, and the "Proclamation on promulgating of the Royal Decree on establishment and functioning of agricultural cooperatives in Cambodia" (ICA ROAP 2007).

[15] Directions for agricultural water management in Cambodia: a discussion 19–20 March 2013, Phnom Penh, Cambodia.

[16] http://www.foodsecurityatlas.org/khm/country/access/livelihoods

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LIST OF ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ASSDP	Agriculture Sector Strategic Development Plan
CARD	Council for Agricultural and Rural Development
CARDI	Cambodian Agricultural Research and Development Institute
CBNRM	community-based natural resource management
CC	Commune Council
CDRI	Cambodia Development Resource Institute
CEDAC	Cambodian Center for Study and Development in Agriculture
D&D	decentralization and deconcentration
EIC	Economic Institute of Cambodia
ELCs	economic land concessions
FC	farmer cooperative
FGD	focus group discussion
FWUC	farmer water user community
FWUG	farmer water user group
GDP	gross domestic product
GMAC	Garment Manufacturers Association in Cambodia
ha	hectare
ICM	integrated crop management
ISF	irrigation service fees
IWMI	International Water Management Institute
IWRM	integrated water resources management
JICA	Japan International Cooperation Agency
LAs	local authorities
MAFF	Ministry of Agriculture, Forestry and Fisheries
MDGs	Millennium Development Goals
Mha	million hectares
MLMUPC	Ministry of Land Management, Urban Planning and Construction
MoE	Ministry of Environment
MoWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
MRD	Ministry of Rural Development
mt	metric ton
NCDD	National Committee for Sub-national Democratic Development
NGO	Non-Governmental Organization
NSDP	National Strategic Development Plan
OAE	Office of Agriculture Extension
O&M	operation and maintenance
PDA	Provincial Department of Agriculture
PDAFF	Provincial Department of Agriculture, Forestry and Fisheries
PDoE	Provincial Department of Environment
PDoWRAM	Provincial Department of Water Resources and Meteorology
PDRD	Provincial Department of Rural Development
PIMD	Participatory Irrigation Management and Development
RGC	Royal Government of Cambodia
RMA	Rice Millers Association
RS	Rectangular Strategy for Growth, Employment, Equity and Efficiency
SAW	Strategy for Agriculture and Water
SFFSN	Strategic Framework for Food Security and Nutrition in Cambodia
SLCs	social land concessions
SME	small and medium enterprises
TWGAW	Technical Working Group on Agriculture and Water
UNDP	United Nations Development Programme

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