*Journal of Developments in Sustainable Agriculture 1: 25–33 (2006)*

# A Review of the Current Situation for Water Resources Management and the Role of Agricultural Education in Cambodia

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This paper highlights a brief profile of the water resources, management and policies of the Royal Government of Cambodia (RGC). The report is based on secondary information from the RGC, Ministry of Water Resources and Meteorology (MOWRAM), Cambodian Development Committee (CDC), Mekong River Commission (MRC), Ministry of Agriculture, Forestry and Fisheries (MAFF), Royal University of Agriculture (RUA) and other related sources. The total land area of Cambodia is 181,035 $km^2$ while the population is approximately 13.8 million. Cambodia currently has a very high potential for water and water resources with limited capability to adopt water for both agricultural production and daily usage. Water resources are being promoted by various developmental policies from the RGC under the support of the government itself and international agencies and organizations. There are 207 Farmer Water User Communities (FWUC) that have been established and are functioning. In the rainy and dry seasons, the FWUC can irrigate 76,720 ha and 59,770 ha, respectively. Only 15% of the populations in 19 of 24 provincial towns have access to piped water. Agriculture in Cambodia is mostly rain fed. Only a small percentage of total cultivated land is irrigated year-round. Irrigation is only available for 4.5% of the total usable land. Of that amount, 1.4% is by surface water irrigation and 3.1% by groundwater irrigation. On the other hand, total irrigated land is approximately 20% of the total cultivated land.

A legal framework, water policies and duties to support sustainable and effective uses of Cambodian water have been established. The FWUC has been designed to accomplish many objectives aiming to attain sustainable water use. There are very few courses provided through higher educational institutions such as the Royal University of Agriculture (RUA) and Institute of Technology of Cambodia (ITC), most courses available are not fully related to agricultural production or livelihood. RUA offers courses directly related to water for agriculture and rural development, but few courses with expertise and support. Academic research focuses on irrigation systems, water contamination and pollution, and water supply with limited concepts for application. Cambodia needs to develop new crops, rice varieties, and other breeding species, to determine the water potential throughout the country, to disseminate maintenance techniques, skills and sustainable use of irrigation facilities, and to introduce specific courses and programs at educational institutions that play a role in the related fields.

**Key words**: Water Resource Management, Agricultural Education, Cambodia

## 1. Introduction

Water is the most important natural resource and is indispensable among all natural resources for supporting comprehensive social development and in particular, for sustaining plants, animals and human beings. Cambodia is a country considered to have abundant water. Its rivers and streams, lakes, aquifers and marine waters are an important resource for national economic development in many areas such as agriculture, manufacturing, small-scale industries, hydropower, navigation,

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tourism, environmental protection and daily life.

The purpose of this country report is to present to the participants of the 2005 TSUKUBA ASIAN SEMINAR ON AGRICULTURAL EDUCATION, the current situation of water resources management in Cambodia. It also includes a review of the role of agricultural education in Cambodia as related to water resources management. The report is based on secondary information from the Royal Government of Cambodia, Ministries concerned, and other related sources with the following specific objectives:

−To highlight the current situation of water resources management in Cambodia,

−To review some parts of the government policies and strategies related to water resources management, and

−To review the status of water and agricultural education in Cambodia.

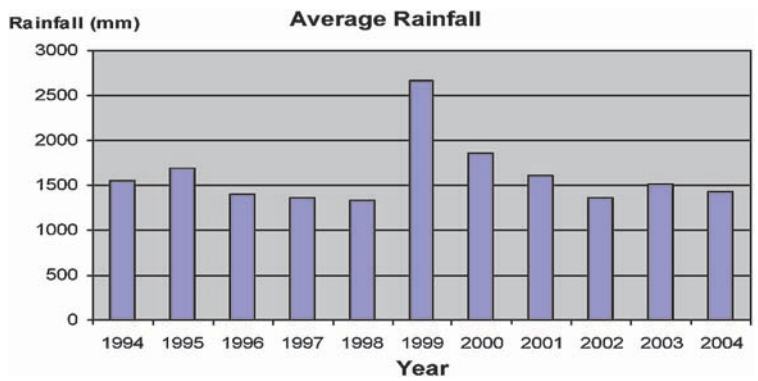
## 2. General Situation of Cambodia

***2.1. Geography, Climate and Population***: As stated in MoP (2003), Cambodia has a land area of 181,035 $km^2$ in the southwestern part of the Indochina Peninsula. The capital city of Cambodia is Phnom Penh. International borders are shared with Thailand on the west, Laos P.D.R. on the north and Vietnam on the east and southeast. Its climate is dominated by monsoons that are known as tropical wet and dry because of distinctly marked seasonal differences. January is the coldest month and April is the warmest. Average annual rainfall is between 1,000 and 1,500 millimeters with the heaviest rainfall in the southeast. The relative humidity is high at night throughout the year. During the daytime in the dry season, humidity averages about 50% or slightly lower but it may remain at approximately 60% during the rainy season.

The population projection in 2003 based on the General Population Census of Cambodia for 1998 was 13.8 million, of which 52% were females. The growth rate is estimated at 2.5% per annum. The population density is 67 persons per $km^2$. Approximately 84% of the population lives in rural areas. Phnom Penh has an estimated population of 1.0 million and annual growth rate of 3.5%.

***2.2. River Systems and the Great Lake "Tonle Sap"***: The Mekong River is the largest river in Cambodia and dominates the hydrology of the country. At Phnom Penh, with its alternate arms, the Bassac River from the south and the Tonle Sap River, link with the "Great Lake" Tonle Sap from the northwest and continues further southeastward to its lower delta in Vietnam.

The role of Tonle Sap as a buffer of the Mekong River system in flood mitigation and a source of beneficial dry season flows warrants explanation. By about mid June, the flow of the Mekong and Bassac Rivers fed by monsoon rains increases to the point that the outlets through the delta cannot handle the enormous volume of water, so it floods extensive adjacent floodplains for 4−7 months. At this point, instead of overflowing the banks, the floodwaters reverse their flow to the Tonle Sap River (about 120 km in length), which then has a maximum inflow rate of 1.8 $m^3/s$, and enters the




Source: MOWRAM (2005)

**Fig. 2.1.** Average annual rainfall in Cambodia from 1994 to 2004.

Great Lake. This characteristic of the Tonle Sap River makes it the only "river with return' in the world. The Great Lake increases in size from about 2,600 $km^2$ in the dry season to up to 13,000 $km^2$, and the water levels rise by an average of 7 meters at the height of flooding (MoP, 2003).

## 3. Government policies and Strategies related to water resources management

***3. 1. Water responsible institutions***: In Cambodia, institutions having responsibility for water resources are; the Cambodia National Mekong Committee (CNMC), Ministry of Water Resources and Meteorology (MOWRAM), Ministry of Industry, Mines and Energy (MIME), Ministry of Rural Development (MRD), Ministry of Public Works and Transport (MPWT), Ministries of Environment (MoE), Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Economics and Finance (MEF), Ministry of Health (MoH), Provincial Governments, Municipalities, and Development Committees (MOWRAM, 2001).

### *3. 2. National Water Resources Policy*

*3. 2. 1. The Rectangular Strategy*: In the second element of the second rectangle of the rectangular strategies addressed by Prime Minister Hun Sen (2004), "*Management of water resources and irrigation*" has been stated to be one of the four major elements in the rectangle. It is a part of a broad program to protect, manage and ensure sustainable exploitation of both freshwater and marine resources while enhancing bio-diversity and sustainability for equitable benefit to the public. The objectives are to anticipate and prepare Cambodia to meet the growing challenges facing its water resources over the next 20 years by adopting relevant measures.

This strategy focuses on providing all citizens with clear and safe water, protecting all citizens from water-related diseases, providing adequate water supplies to ensure food security, economic activities and appropriate living standards, and ensuring that water resources and the environment are free from toxic elements, while enabling supportive fisheries and ecological systems. The RGC plans to also develop and expand irrigated lands and effective water resources management by improving the efficient use of exiting irrigation systems, further developing and enhancing the effectiveness of water communities and reducing the vulnerability of the population to natural disasters and their total dependence on natural conditions.

*3. 2. 2. Policy of Water for Agriculture*: Cambodia' s population is predominantly rural and agricultural. Rice is the dominant food and cash crop. In some areas with good access to markets, crops such as corn and sugar cane are also produced, while many rural people raise their own livestock and poultry, have home gardens and orchards, and raise fish. Most crop production depends on rainfall and every year farmers face shortages of water, drought and floods that have a major impact on agricultural production. The irrigation infrastructure is in poor condition and unable to provide enough water for agricultural production with only about 20% of cropland receiving any form of irrigation. The same is true of facilities for mitigating the adverse impacts of waterlogging and periodic flooding. Participation of the beneficiaries in the planning, construction, management and operation of irrigation, drainage and flood control infrastructures is limited, but is being promoted in part by the Prime Minister's Circular No. 01 SR, 11 January 1999.

To address the above issues, MOWRAM (2000) emphasizes the following policies of the RGC:

–Provide farmers with the quality of water they need, when and where they need it, at a cost they and the wider community can afford, and within the limits of available water resources, technology and financial resources for investment.

–Promote, where justifiable on economic and social grounds, the rehabilitation and construction of irrigation, drainage and flood management infrastructures in order to provide sufficient water for agricultural production and to alleviate the adverse consequences of excess water.

–Promote the development and extension of water management technologies that are particularly suited to rain-fed agricultural areas, such as water harvesting, improvements to the moisture-holding capacities of soils, use of farm ponds and sustainable extension from groundwater.

–Strengthen and expand Farmer Water User Communities (FWUC) to enable them to participate in water management and allocation, and maintain an irrigation infrastructure with effectiveness and

sustainability.

## 4. Major Achievements from Implementing a Water Resources Policy

### *4.1. Water Resources*

*4.1.1. Preparation of Legal Framework*: MOWRAM working with other Government institutions and development partners has prepared and submitted to the parliament a draft of a law for water resources management. Subsequently, a national policy on water resources management was prepared and approved by the Council of Ministers in January 2004.

*4.1.2. Rehabilitation of Irrigation Infrastructure, Drought Intervention and River Bank Protection*: MOWRAM has rehabilitated 315 irrigation systems for rice cultivation covering an area of 153,149 ha (rainy season 89,383 ha and dry season 63,766 ha), flood control dikes that now provide protection over an area of 113,500 ha and sea protection dikes (polders) to prevent intrusion of the sea into cultivable land covering an area of 16,680 ha. Droughts are a recurring phenomenon in Cambodia. A high priority was assigned by the RGC to improve river embankments. The embankments along the Mekong River in the provincial town of Kampong Cham, totaling 5.2 km, were restored using resources from the domestic budget (CDC, 2004).

*4.1.3. Farmer Water User Community (FWUC)*: From 1999 to 2003, there has been 207 FWUC (42.800 Families) established and functioning in Cambodia. FWUC cover a land area of 76,720 and 59,770 hectares of rain fed and dry season rice fields, respectively (MOWRAM, 2003).

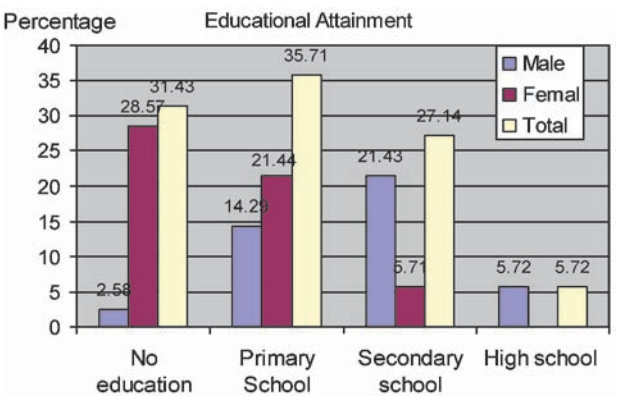
The FWUC is lead by a committee that is elected and has the following members: a chairman, 2 vice chairmen, a treasurer and all chiefs of the farmer water user groups.

According to a study by the Pouk FWUC in Siem Reap Province, many conflicts and problems faced farmers before the formulation a FWUC. Most of the conflicts and problem were resolved after formulation of a community.

A case study of Roung FWUC in Kampong Speu province showed that the general education of farmers is very low. Most of farmers, particularly women are illiterate or have only attained primary education. Only 5.72% of the farmers in this community have been educated in high school with all of them being men.

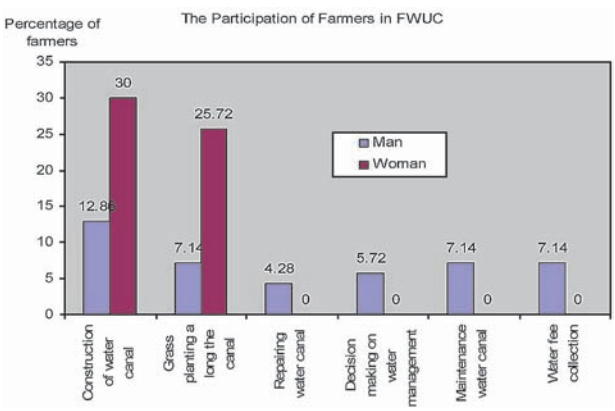
In the practical activities of FWUC, women are much more involved in the construction of water canal systems and planting grass along the water canal systems. Only men are involved in the maintenance and repair of canal systems, and make decisions for water management. Figure 4.2 and table 4.1 below show that gender is not balanced in the FWUC. Very few women contribute their ideas to FWUC management.

***4.2. Potable Water***: The Royal Government's National Policy on Water Supply and Sanitation has set a goal to expand the supply of safe water for




Source: Sodany (2005)

**Fig. 4.1.** Distribution of educational level of farmers in the Roung FWUC of Kompong Speu Province.




Source: Sodany (2005)

**Fig. 4.2.** Distribution of participating activities of farmers in the Roung FWUC of Kompong Speu Province.

**Table 4.1.** The distribution of farmer participation in the meetings of Roung FWUC

| Participating in meeting | | | | Contributing ideas to meeting | | | |
|---|---|---|---|---|---|---|---|
| Participation (%) | | Non-participation (%) | | Contribute | | Never contribute | |
| Men | Women | Men | Women | Men | Women | Men | Women |
| 38.86 | 40 | 5.71 | 18.58 | 41.43 | 7.14 | 2.85 | 48.57 |

Source: Sodany (2005)

improving the living standards and welfare of the people in order to reach the Cambodian Millennial Development Goals. The support of international financial institutions and donor countries has been sought to rehabilitate and construct water supply systems that respond to the urgent needs of the people. RGC has also sought participation of the private sector in these goals. At present, 85 percent of the population in Phnom Penh and 15% of the population in the provincial towns have access to piped water. Five out of 24 provincial towns, Odor Meanch Chey, Mondul Kiri, Preah Vihear, Pailin and Krong Kep municipalities, have no water supply systems. Over the last five years, significant progress has been made to rehabilitate water systems. The Sihanoukville water supply system has been rehabilitated and expanded to increase supply from 2,000 to 8,000 $m^3$/day with World Bank financing, and 1,320 households have been connected. With financing from ADB (Asian Development Bank) loan, water supply systems in six provincial towns (Battambang, Pursat, Kampong Thom, Kampong Cham, Kampot and Svay Riang) are being rehabilitated and work will be completed in 2005. This project will supply safe water to approximately 10,000 families. With grant aid from Japan, the Siem Reap water supply system is being constructed. The Cambodia Provincial and Peri-Urban water and sanitation project with World Bank financing is being implemented in 43 locations in urban areas (CDC, 2004).

***4.3. Agriculture***: Agriculture in Cambodia is mostly rain fed. Existing irrigation schemes are in disrepair and require rehabilitation or reconstruction; even when functioning, the water control and flow is sub-standard. As a result most of the schemes only actually provide supplementary irrigation water for seasonal production. Areas irrigated in one season are not irrigated year-round. Only a small percentage of the total cultivated land is irrigated year-round. Irrigation covers only 4.5% of the total usable land. Of that amount, 1.4% consists of surface irrigation and 3.1% of groundwater irrigation. Moreover, total irrigated land is about 20% of the total cultivated land (MOWRAM, 2001).

MOWRAM (2001) also indicated that a limited quantity of surface freshwater has been exploited for irrigation. An inventory of irrigation systems in various studies initiated in 1993 and 1994 show there were 841 irrigation systems throughout Cambodia. Of these only 21% were reported operational. A recent list showed that currently Cambodia has in place 946 systems that can irrigate 256,120 and 143,490 hectares, in the wet and dry seasons, respectively. This means that out of the current 2.06 million ha of land cultivated with wet season rice only a small fraction (12.4%) receives irrigation water and the remaining land is rain fed. During the dry season more than half (55.21%) of the cultivated dry season rice land, 259,919 hectares, can receive irrigation water from the existing systems, while the remaining areas are perhaps under recession cropping conditions and fed by small and medium scale pumping.

***Rice production***: The year 2004 was a difficult year for rain fed rice cultivation. The total rice production of 2004 was less than the production of 2003. The rice cultivated areas of 2004 were more than 2003 and damaged areas more than in 2003. This was due to a lack of water. The average annual rainfall was less than in 2003 (serious drought in some areas) and also not fairly distributed (Fig. 2.1).

Rice cultivation in the dry season of 2004–05 was good compared with the last several years. The yield increased slightly and there were fewer

**Table 4.2.** A comparison of rice farming production in the rainy season from 2000–2004

| Year | Cultivated Land (in ha) | Damaged Land (in ha) | Harvested Land (ha) | Yields (t/ha) | Quantity (in t) |
|---|---|---|---|---|---|
| 2000 | 2,129,730 | 481,918 | 1,647,812 | 1.949 | 3,212,269 |
| 2001 | 1,974,048 | 250,663 | 1,723,385 | 1.901 | 3,275,953 |
| 2002 | 1,845,135 | 135,483 | 1,709,652 | 1.706 | 2,915,900 |
| 2003 | 2,032,303 | 65,267 | 1,967,036 | 1.951 | 3,837,957 |
| Average 2000–03 | **1,995,304** | | **1,761,971** | **1.879** | **3,310,520** |
| 2004 | 2,075,646 | 260,027 | 1,815,619 | 1.725 | 3,132,581 |
| Compared to 2003 | +43,343 | | −151,417 | | −705,376 |
| Compared to 2000–03 | +80,342 | | +53,648 | | −177,939 |

Source: MAFF (2005)

**Table 4.3.** A comparison of rice farming production in the dry season from 2000–2004

| Year | Cultivated Land (in ha) | Damaged Land (in ha) | Harvested Land (in ha) | Yields (t/ha) | Quantity (in t) |
|---|---|---|---|---|---|
| 2000 | 259,847 | 4,500 | 255,347 | 3.187 | 813,823 |
| 2001 | 266,869 | 9,959 | 256,910 | 3.204 | 823,063 |
| 2002 | 291,990 | 6,997 | 284,993 | 3.181 | 906,609 |
| 2003 | 283,550 | 8,550 | 275,000 | 3.175 | 873,000 |
| Average 2000–03 | **275,564** | **7,502** | **268,063** | **3.187** | **854,124** |
| 2004 | 298,529 | 5,098 | 293,431 | 3.536 | 1,037,703 |
| Compared to 2003 | +14,979 | −3,452 | +18,431 | +0.362 | +164,703 |
| Compared to 2000–03 | +22,965 | −2,404 | +25,369 | +0.350 | +183,579 |

Source: MAFF (2005)

**Table 4.4.** Total of rice production (rainy and dry seasons) in the year 2004–05

| Item | Unit | Rainy season | Dry season | Total |
|---|---|---|---|---|
| Planned | ha | 2,174,000 | 287,600 | 2,461,600 |
| Cultivated areas | ha | 2,048,360 | 298,529 | 2,346,889 |
| Damaged areas | ha | 260,027 | 5,098 | 265,125 |
| Replanted areas | ha | 27,286 | — | 27,286 |
| Harvested areas | ha | 1,815,619 | 293,221 | 2,108,840 |
| Average yields | t/ha | 1.725 | 3.539 | 1.978 |
| Production | t | **3,132,581** | **1,037,703** | **4,170,284** |

Source: MAFF (2005)

damaged areas.

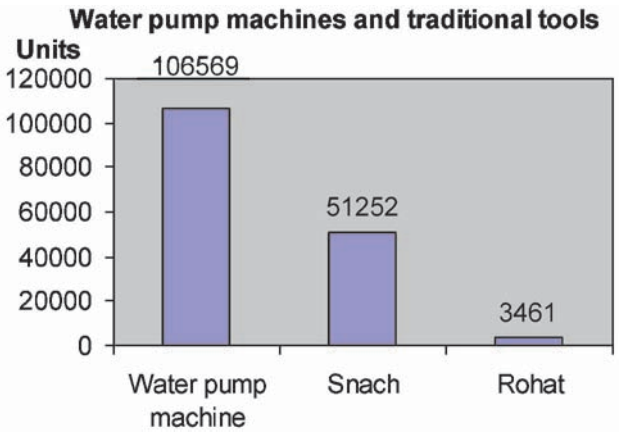
Even though the total rice production in 2004 was less than 2003, it provided enough food for the Cambodian people during the entire year, actually farmers use their rice for more purposes than food, such as animal feed, gasoline, fertilizer and chemicals (Table 4.2 & 4.3).

***Mechanization for irrigation***: For supplementary irrigation of their rice fields, farmers use water pumps for surface water and ground water. Some places farmers still use traditional water tolls, such as Snach and Rohat (local names).

**Table 4.5.** Total food balanced (rice) for year 2005

| Items | Total (t) |
|---|---|
| Total annual rice production | 4,170,284 |
| Reduction of 13% for seed reserve and post harvest losses | 542,137 |
| Remaining paddy available for consumption | 3,628,147 |
| Available rice for consumption converted into mills of rice at a 64% milling-rate | 2,322,014 |
| Food requirement per year (140 kg/person/year) | 1,905,896 |
| Surplus production of rice | +41,6118 |

Source: MAFF (2005)




Source: DOAM (2004)
**Fig. 4.3.** The number of water pumps and traditional tools used in agriculture.

***4.4. Domestic Water Supply in Rural Areas***: Most people in the rural areas obtain water for domestic use from wells (open & tube wells), rivers and natural streams, reservoirs and ponds. In 2003 the statistics of MOWRAM indicated that there are 137,121 wells and 13,598 ponds in 17 provinces used by people for domestic and irrigation purposes. Only 2 provinces (Takeo and Prey Veng) have used ground water for irrigating rice and crops. Takeo faces problems of chemical substance contamination resulting in unsafe water (MOWRAM, 2003).

***4.5. Environment and Conservation***: CDC (2004) reported there are 23 areas that are protected under the Law on Environment Protection and Natural Resources Management. The protected areas are classified into four management zones namely core zone, conservation zone, sustainable development zone and community zone.

The Ministry of Environment has made concerted efforts for biodiversity conservation in three core areas of the Tonle Sap Biosphere Reserve by constructing environmental stations for conducting research, monitoring biodiversity, organizing management groups and conducting environmental awareness and educational activities as well as capacity building for park rangers. A mechanism for cooperation between the relevant ministries for sustainable management of the Tonle Sap Biosphere Reserve has been created to facilitate effective reforms of land use, forestry and fisheries and creation of community organizations for natural resources management.

To ensure water pollution prevention, 48 factories that were adversely affecting the environment have been forced to install wastewater treatment facilities. Also, some main canals and the sewerage system of Phnom Penh have been restored and repaired with support from JICA. Wastewater treatment facilities have been built in Shihanoukville and Battambang Provinces.

## 5. Water and Agricultural Education

***5.1. Water/Agricultural Education Institutions***: As of the year 2005, there are 40 higher educational institutions with 10 providing advanced degrees and seven universities and three institutes in Cambodia. Among the 40 institutions, there are only two main institutions, the RUA and Institute of Technologies of Cambodia (ITC) that have curricula related to water including water supplies, drainage and irrigation systems.

*5.1.1. Royal University of Agriculture*: RUA was established in 1964 and is composed of eight fac-

ulties; Agronomy, Animal Sciences and Veterinary Medicine, Forestry, Fisheries, Agricultural Technology and Management, Agricultural Economics and Rural Development, Agro-Industry, and Land Management and Administration. RUA offers bachelor and master degree programs as well as short training courses.

Four of the eight faculties have significant water related courses in their curricula. The most directly related program is in the *Faculty of Agricultural Technology and Management* with hydrology, ground water, irrigation and drainage systems, pumping for agricultural production as the most important concepts of its curriculum. Due to a lack of equipment and laboratory space the faculty seems to becoming less important and loosing its role in teaching about water irrigation systems. The curriculum of the *Faculty of Agronomy* includes subjects of water for crop production, crop ecology and soil and water management. The *Faculty of Fisheries* provides courses related to sea and freshwater aquaculture. Water contamination and treatment are also taught in this faculty. Research related to water quality is conducted in this faculty. The last is the *Faculty of Forestry* offering a course on watershed management that can be excluded. Even, the other four faculties have some courses relating to water but are not specialized and cannot provide expertise for the future.

*5. 1. 2. Institute of Technology of Cambodia (ITC)*: ITC has programs related to rural engineering and hydrology. The programs provide educational development mainly related to rural infrastructural improvement and maintenance. However, these programs are not related to drainage, irrigation systems or water supply and sanitation.

*5. 3. 3. Other Institutions*: There are also other institutions such as Prek Leap National School of Agriculture (PLNSA), Kampong Chham National School of Agriculture (KCNSA), and Moharussey Vedic University (MVU) that offer courses in agriculture and some water concepts related to agricultural production.

***5. 2. Water and Agricultural Research***: Effective use of water is the main topic for research related to water within the water-agricultural organizations, CARDI (Cambodian Agricultural Research and Development Institute), RUA and JICA. CARDI has carried out research that can be considered to relate to more effective use of water such as innovation of new rice varieties and land leveling (Mak Solieng *et al*., 2000). RUA conducts research on water use efficiency and water pollution in peri-urban Phnom Penh City. There is also some research being conducted to strengthen the FWUC process and sustainability. JICA also plans projects on how to use water for agricultural production and water planning in some provinces such as Battambang, Kompong Cham and Siem Reap. Water pollution and waste treatment are also being considered by JICA.

## 6. Conclusion

Cambodia has a very high availability of water and water resources. However, capabilities to adopt these sources for usage in both agricultural production and daily life are very limited. Water for agriculture is very limited and is being promoted by various developmental policies from the RGC under the support of government itself and international agencies and organizations. Water for daily usage, potable water, can only be accessed in the cities and provincial towns.

Existing irrigation systems and water supplies are undergoing rehabilitation and difficult to maintain. MOWRAM under the policies of RGC has established a legal framework, water policies and duties to support the sustainable and effective use of Cambodian water. Irregular rainfall has a negative impact on present crop production of Cambodian conventional agriculture. The FWUC has been widely implemented and seem to be successful in contributing to sustainable use of water for life and all other purposes.

In addressing the use of water and managerial support of the policies, Cambodia seems to be lacking in its educational programs. There have been very few courses offered by the Higher Educational Institutions such as RUA, ITC, etc. In addition, the courses are not specific and not closely related to agricultural production and domestic water use. RUA concentrates on water for agriculture and rural development, but offers only few courses with limited expertise and support. Academic research focusing on irrigation systems, water contamination, water pollution and water supplies only cover very basic concepts and applications.

## 7. Recommendations

Even though the policies on water seem to be strong as indicated, it is only the process and they are not yet clearly defined. In conclusion, the following ideas can be identified as recommendations for consideration.

–Crop types, rice varieties and new breeding species need to be produced with the new climatic conditions.

–Water potential determination should be implemented throughout the country so that water use will be more efficient.

–Maintenance techniques, skills and the ways to sustain usage of the existing irrigation systems and water supplies need to be disseminated to the consumers of those systems.

–Water management, water treatment, irrigation and drainage systems, and other water related courses must be specifically incorporated into the academic programs of higher education, because the institutions play a very important role in these areas.

## Acknowledgments

The author wishes to express his deepest gratitude and acknowledge his advisor Dr. TOYOAKI MORISHITA, JICA Senior Volunteer to RUA, for his cooperation, support and introduction to the 2005 TASAE.

Special acknowledgment is also due to Prof. Dr. Iwasaki Yoichi, President of the University of Tsukuba and Prof. Dr. Haruyuki Mochida, Chairperson of 2005 TASAE for inviting him to participate in the seminar.

He also expresses his gratitude to Prof. Satoh and Mr. Busia for their comments on the report writings.

Acknowledgements and appreciation are also due to his colleagues Mr. Chun Nimul and Mr. Sun Chamnan for their helpful support in writing this report.

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