The review of current situation of water resources management and the role of agricultural education in Cambodia

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Summary:

The paper highlights a brief profile of the water resources, management and policy of the Royal Government of Cambodia (RGC). The report is based on the secondary information of the RGC, Ministry of Water Resources and Meteorology (MOWRAM), Cambodian Development Committee (CDC), Mekong River Commission (MRC), Ministry of Agriculture, Forestry and Fishery (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 about 13.8 million. Cambodia currently has very high potential of water and water resources with limited capability to adopt water for both agricultural production and daily usage and is being promoted by various kind of development policy from the RGC under the support of government itself and international agencies / 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 the 19 out of 24 provincial towns have access to piped water. Agriculture in Cambodia is mostly rainfed. Only a small percentage of total cultivated land is irrigated year-round. Irrigation is only available for 4.5% of 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 about 20 % of total cultivated land.

Legal framework, water policy, and duties for supporting the sustainable and effective Uses of Cambodian water have been established. The FWUC has been designed to

accomplish many objectives aiming at attaining sustainable water use. There have been very few courses provided within the Higher Educations such as Royal University of Agriculture (RUA), Institute of Technology of Cambodia (ITC), but not fully related to neither agricultural production nor livelihood. RUA is directly related to water for agriculture and rural development, but can deliver only few courses with least expertise and support. The academic researches focusing on the irrigation system, water contamination and pollution, and water supply have limited concepts for application. It is recommended to find out crop types, rice varieties, and other breeding species, to determine the water potential throughout the country, to disseminate the maintenance techniques, skills, and way of sustainable use of irrigation facilities, and to introduce specific courses or programs to institutions that are playing a role in the related field.

Keywords: Water Recourse Management, Agricultural Education, Cambodia

1. Introduction

Water is the most important natural resource, which is indispensable among all natural resources for supporting comprehensive social development and in particular for sustaining plant, animal and human being. Cambodia is a country that is 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, tourism, environmental protection, and daily life.

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

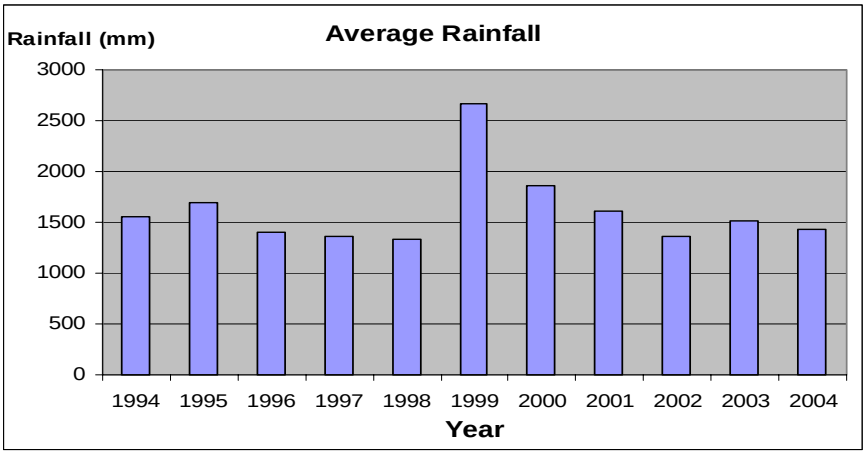
- To highlight the current situation of water resources management in Cambodia,

- To review some parts of Government policy and strategies related with 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 and Laos P.D.R. on the west, the north respectively and Vietnam on the east and southeast. Its climate is dominated by the monsoon, which 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 fall 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 about 60% in the rainy season.



Source: MOWRAM (2005)

Figure 2.1: An average annual rainfall in Cambodia from 1994 to 2004

The population projection in 2003, based on the General Population Census of Cambodia 1998 is 13.8 million, of which 52% are females. The grow rate is estimated at 2.5% per annum. The population density is 67 persons per km2. Around 84% of population lives in

rural areas. Phnom Penh has an estimated population of 1.0 million and annual rate of grow at 3.5%.

2.2. River Systems and the Great Lake "Tonle Sap": Mekong River is the largest river in Cambodia and dominates the hydrology of the country. At Phnom Penh, with its alternative 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 the source of beneficial dry season flows warrants explanation. By about mid June, the flow of Mekong and Bassac Rivers fed by monsoon rains increases to the point where its outlets through the delta cannot handle the enormous volume of water, flooding extensive adjacent floodplains for 4-7 months. At this point, instead of overflowing its banks, the floodwaters reverse its flow to the Tonle Sap River (about 120 km in length) which then has a maximum inflow rate of 1.8 m3/s and enters the 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 the flooding (MoP, 2003).

3. Government policy and Strategy related with water resources management

3.1. Water responsible institutions: In Cambodia, institutions having responsibility related with water resources are; 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, Fisheries and Forests (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 broad program to protect, manage and ensure sustainable exploitation of both fresh-water and marine resources while enhancing bio-diversity and sustainability for equitable benefit to the public. The objectives are to anticipate and prepare ourselves to meet the growing challenges facing Cambodia's water resources in next 20 years by adopting relevant measures.

These will focus on; providing all citizens with clear and safe water, protecting all citizens from water-related diseases, providing adequate water supply 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 a supportive fisheries and ecological system. The RGC will also develop and expand irrigated lands and effective water resources management by improving the efficient use of exiting irrigation systems, further development and enhancing the effectiveness of water communities and reducing the vulnerability of the population to natural disasters and its 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 in which there is good access to markets, crops such as corn and sugar cane also are produced, while, many rural people raise their own livestock and poultry, have home gardens and orchards, and raise catch fish. Most crop production depends on rainfall and every year, farmers face shortages of water, drought, and floods, and these have a major impact on agricultural production. The irrigation infrastructure is in poor condition and is unable to provide enough water for agricultural production with only about 20% of cropland receives from any form of irrigation.

The same is true of facilities for mitigating the adverse impacts of water-logging and periodic flooding. Participation of the beneficiaries in the planning, construction, management and operation of irrigation, drainage and flood control infrastructure 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) mentioned about the policies of RGC as the followings:

- To 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 resource for investment,

- To promote, where justifiable on economic or social grounds, the rehabilitation and construction of irrigation, drainage, and flood management infrastructure, in order to provide sufficient water for agricultural production and to alleviate the adverse consequences of excess water,

- To 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, and

- To strengthen and expand Farmer Water User Communities (FWUC), to enable them to participate in water management and allocation and maintain irrigation infrastructure with effectiveness and sustainability.

4. Major Achievement of Implementing 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 Law on Water Resources Management. Subsequently, a National Policy on Water Resources Management was prepared and approved by the Council of Ministers in January 2004.

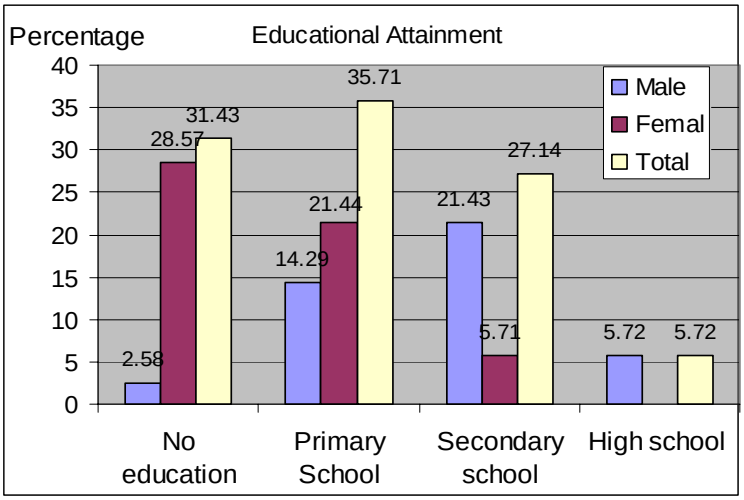
4.1.2. Rehabilitation of Irrigation Infrastructure, Drought Intervention and River Bank Protection: MOWRAM has rehabilitated: 315 irrigation systems for rice cultivation covering an area of 153,149 ha (rainy season 89,383 ha and dry season 63,766 ha); Flood Control Dikes that now provide protection over an area of 113,500 ha, and sea protection Dikes (Polders) to protect sea intrusion into the cultivable land an area covering 16,680 ha. Droughts are a recurring phenomenon in Cambodia. A high priority was assigned by the RGC to improve river embankments. The embankment along the Mekong River in the provincial town of Kampong Cham, totaling 5.2 km, was restored using domestic budget resources (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 the whole Cambodia. FWUC covers the land area of 76,720 and 59,770 hectares of rainfed and dry season rice fields respectively (MOWRAM, 2003).

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

According with the study of Pouk FWUC in Siem Reap Province, we found that many conflicts and problems that faced by farmers before formulation a FWUC. Most of conflicts and problem has been solve after formulate a community.

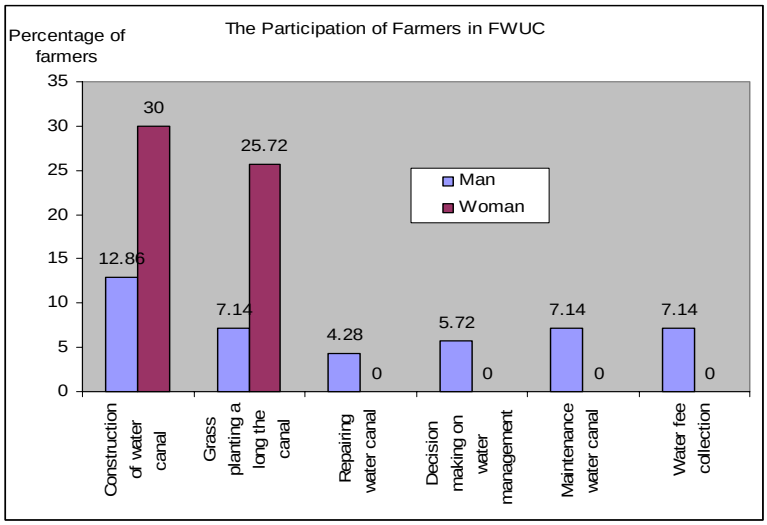
A case study of Roung FWUC in Kampong Speu province found that the general education of farmers was very low. Most of them, particularly women are literacy or attained primary education. Only 5.72 % of the farmers in this community have been educated in high school, but all of them are men.



Source: Sodany (2005)

Figure 4.1. Distribution of educational attainment of farmers in Roung FWUC of Kompong Speu Province

In the practical activities of FWUC, women are much more involved in the construction of water canal system and grass planting along the water canal system. Only men that involved in the maintenance and repairing of canal system and make the decision for water management. The figure and table below show that there is no gender balanced in the FWUC. Only very few of women have ability to contribute their ideas to FWUC management.



Source: Sodany (2005)

Figure4.2. Distribution of participating activities of farmers in Roung FWUC of Kompong Speu Province

Table 4.1. The distribution of farmer participations to meeting 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)

4.2. Potable Water: The Royal Government's National Policy on Water Supply and Sanitation has set the goal of expanding the supply safe water to improve the living standards and the welfare of people to reach Cambodian Millennium Development Goals. The support of international financial institutions and donor countries has been sought to rehabilitate and construct water supply systems to respond the urgent needs of the people. RGC has also sought the participation of the private sector in this sector. At present, 85 percent of the population in Phnom Penh and 15 % of the population in the provincial towns has access to piped water. Out of 24 provincial towns, five 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 the water systems. With WB financing, the Sihanoukville Water Supply system has been rehabilitated and expanded to increase supply from 2,000 to 8,000 m3/day, and 1,320 households have been connected. With financing from ADB 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 about 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 are actually only

providing supplementary irrigation water to seasonal production. Irrigated areas in one season are not irrigated year-round. Only a small percentage of total cultivated land is irrigated year-round. Irrigation covers only 4.5 percent of total usable land. Of that amount, 1.4 percent consists of surface irrigation and 3.1 percent of groundwater irrigation. On the other hand, total irrigated land is about 20 percent of total cultivated land (MOWRAM, 2001).

MOWRAM (2001) also indicated that the limited quantity of surface freshwater has been exploited for irrigation. The inventory of irrigation systems in various studies initiated in 1993/1994 show that there were 841 irrigation systems throughout Cambodia. Of these only 21 percent were reported to be operational. A recent listing showed that currently Cambodia has in place 946 systems, which can irrigate 256,120 and 143,490 hectares, respectively, in wet and dry season. This means that out of the current 2.06 million hectare cultivated area of wet season rice land only a small fraction (12.4 percent) could receive irrigation water and the remaining area under rainfed. During the dry season more than half (55.21 percent) 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 condition and fed by small and medium scale pumping.

Rice production: Year 2004 is the difficult year for rainfed rice cultivation. The total of rice production in 2004 is less than the production of 2003. The rice cultivated areas of 2004 is more than 2003 but damaged areas is more than in 2003. This is due to the lack of water. The average annual rainfall were less than 2003 (serious drought in some areas) and also not fairly rainfall (Figure2.1).

Table4.2. A comparison of rice farming production in 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)

Rice cultivation in dry season of 2004-05 is good compared with last several years. The yield is increased a little bit higher. Less damaged areas.

Table 4.3: **A comparison of rice farming production in 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)

Even though the total of rice production in 2004 is less than 2003, this product can provide enough food to the Cambodia people in a whole year, but actually our farmers use their rice for more purposes other than food, such as animal feed, gasoline, fertilizer or chemical (Table and).

Table4.4. Total of rice production (Rainy and dry season) in 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**

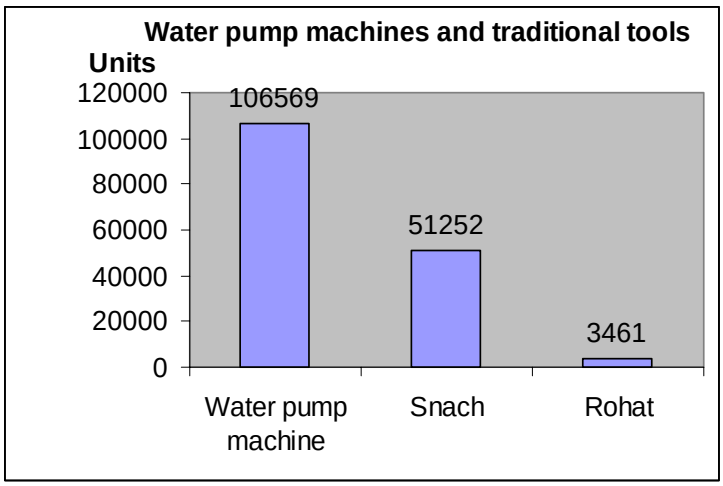
Source: MAFF (2005)

Table4.5. 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 rice 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)

Mechanization for irrigation: For supplementary irrigation of their rice field, farmers use water pump machines for surface water and ground water. Some place farmers still use traditional water tolls, such as Snach and Rohat (local names).



Source: DOAM (2004)

Figure 4.3: The statistic of water pump machines and traditional tools use in agriculture

4.4. Domestic Water Supply in Rural Area: Most of people in the rural area obtain water for domestic use from wells (open & tube wells), rivers and natural streams, reservoirs and ponds. In 2003 the statistic of MOWRAM indicated that there are 137,121 wells and 13,598 ponds have been used by people in 17 provinces for domestic and irrigation purposes. Only 2 provinces (Takeo and Prey Veng) have used ground water for irrigated rice crop. Takeo is facing the problem of chemical substance contamination mainly the unsafe water (MOWRAM, 2003).

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

The Ministry of Environment has made concerted efforts on biodiversity conservation in the three core areas of Tonle Sap Biosphere Reserve by constructing environmental stations for research and monitoring biodiversity, organizing of management groups, conducting environmental awareness and educational activities as well as capacity building for park rangers. A mechanism for cooperation between relevant ministries for sustainable management 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 resource management.

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

5. Water and Agriculture Education

5.1. Water / Agricultural Education Institutions: In the year 2005, there are 40 higher education institutes in Cambodia. There are ten public higher education institutes providing degree level in Cambodia; seven universities and three institutes. Among the 40 institutions, there are only two main institutions; RUA and Institute of Technologies of Cambodia (ITC) have curricula related to water including water supply, drainage, and irrigation system.

5.1.1. Royal University of Agriculture: RUA was established in 1964 and composed of eight faculties; Agronomy, Animal Sciences and Veterinary Medicine, Forestry, Fisheries, Agricultural Technology and Management, Agricultural Economics and Rural Development,

Agro-Industry and Land Management and Administration. It offers bachelor and master degree programs as well as short training courses.

Four out of the eight faculties have significantly water related subjects inserted into their curricula. The most directly related one is *Faculty of Agricultural Technology and Management* in which hydrology, ground water, irrigation and drainage systems, pumping work for agricultural production are the most important concepts of its curriculum. Due to the lack of equipments and laboratory the faculty seems to be less important and loosing its role in water irrigation system. The curriculum of the *Faculty of Agronomy* includes the subjects in need of water for crop production, crop ecology and soil and water management. *Faculty of Fisheries* is providing courses related to sea and fresh water and aquaculture in Cambodia. The water contamination and treatment are also taught in this faculty. Several researches related to water quality have been conducted in the faculty. The last one, *Faculty of Forestry* has a course on watershed management that can be excluded. Even, the four faculties have some courses relating water but they are all not the specialized one and cannot be expertise in the future.

5.1.2. Institute of Technology of Cambodia (ITC): ITC has programs related to rural engineering and hydrology. The programs serve the educational development mainly related to rural infrastructure improvement and maintenance. However, it is related neither to the drainage and irrigation system nor water supply and sanitation.

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

5.2. Water and Agricultural Research: How to use water effectively 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 as the relation to use water more effective such as innovation of new rice varieties and land leveling (Mak Solieng et al, 2000). RUA has research studies on water use efficiency and water pollution in the peri-urban of Phnom Penh city. There are also some research studies in terms of theses being conducted to strengthening the FWUC process and sustainability as well. JICA also projects the planning of how to use water for agricultural production and water planning of Cambodia and some other provinces such as Battambang, Kompong Cham, and Siem Reap. The water pollution and waste treatment are also being considered by JICA.

6. Conclusion

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

The existing irrigation system and water supply are under rehabilitation and least capability to maintain. To sustain use, MOWRAM under the policy of RGC has established legal framework, water policy and duties for supporting the sustainable and effective use of Cambodian water. Irregular rainfall has a negative impact for the present crops production of Cambodian conventional agriculture. The FWUC has been widely implemented and seems to be successful and will contribute to sustainable water use for life and all other purposes.

Addressing the use of water and managerial support to the policy, Cambodia seems to be lacking in concentrating on its educational program. There has been very few courses provided within the Higher Educations such as RUA, CIT, etc. Though, the courses are not specific and therefore not fully related to neither agricultural production nor domestic use.

RUA is directly related to water for agriculture and rural development, but only few courses with least expertise and support. The academic researches focusing on the irrigation system, water contamination, water pollution and water supply are of very basic concept and application.

7. Recommendations

Even though, the policy on water seems to be strong as indicated, it is only on the process and not yet clearly defined. In conclusion, some ideas can be identified recommended for consideration.

- Crop types, rice varieties and other breeding species need to be reproduced in accordance to the new climate conditions.

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

- Maintenance techniques, skills and way of sustainable usage of the existing irrigation system and water supply need to be disseminated to the consumers of those systems.

- Water management, water treatment, irrigation and drainage system and other water related courses must be specifically considered into the academic program of higher education, since those institutions play very important role in the area.

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References

Borey, Piseth, 2004. **Mechanism development management of existing farmer water user to farmer water user community follow by standard in Otreng Irrigation System, Kong Pisei District, Kampong Speu Province**. (Khmer version).

CDC, 2004. **Implementing the Rectangular Strategy and Development Assistance Needs**. Royal Government of Cambodia.

Chariya Neou, 2004. **The effect of organization of farmer water users community in Chanthnal irrigation system, in Odong District, Kampong Speu Province**. (Khmer version).

DOAM, 2004. Annual Report of Department of Agricultural Mechanization, Ministry of Agriculture, Forestry and Fisheries. (Khmer version)

Hun Sen, 2004. **Rectangular Strategy: For Growth, Employment, Equity and Efficiency**. Royal Government of Cambodia.

MAFF, 2004. **Document of 2003-2004 Annual meeting and direction for 2004-05**. Ministry of Agriculture, Forestry and Fisheries. (Khmer version).

MAFF, 2005. **Achievement of Agriculture, Forestry and Fisheries, 2004**. Ministry of Agriculture, Forestry and Fisheries. (Khmer version).

MoP, 2003. **Statistical Year Book 2003**. Ministry of Planning, Kingdom of Cambodia.

MOWRAM, 2003. **National Water Resources and Meteorology 5 years (1999-2003) Accomplishment**. Royal Government of Cambodia. (Khmer version).

MOWRAM, 2002. **National Water Resources Policy for the Kingdom of Cambodia**. Royal Government of Cambodia.

MOWRAM, 2001. **National Water Sector Profile Kingdom of Cambodia**. Royal Government of Cambodia.

NPRS, 2002. **National Poverty Reduction Strategy 2003-05**. Royal Government of Cambodia.

Mak Solieng, Meas Pyseth, Ty Channa, Men Sarom, and Peter Cox, 2000. "Impact of Agricultural Research on Rice-Based Farming Systems in Cambodia". **Cambodian Journal of Agriculture**, P:1-8, Cambodian Society of Agriculture, Cambodia.

Sodany Kao, 2005. **The role of woman in farmer water user community of Roung Village, Svaykravan commune, Chbamon district, Kompong Speu Province**. (Khmer version).

Sreylan Hy, 2004. **The organization process of farmer water user community of Sdaukaong in Bphnom and Kampong Trobek Districts, Prey Veng Province**. (Khmer version).

Techkung Ear, 2004. **Study on water user community's constraints and opportunities in Pouk District, Siam Reap Province**. (Khmer version).