

## IV. CAMBODIA\*

### A. Assessment of the current state of agriculture, forestry and marine resources

#### 1. Land conservation and rehabilitation

##### (a) Degree of soil erosion

At the time of writing this report there were no data available on the degree of erosion in Cambodia. But because of the high vulnerability of soils to erosion in Cambodia and the accumulated impact on agriculture and the environment, attention urgently needs to be given to the problem. That need is underscored by the following facts:

- (a) Some 63 per cent of Cambodia's forests are located in mountainous watershed areas (Ministry of Environment, 1994), much of which has been extensively logged, deforested or degraded. Loss and reduction of the vegetation cover leads to exposure of the soil to sunlight and heavy rainfall, which speeds up the decomposition rate and therefore decreases organic matter in the soil. The process also brings about changes in the physical and chemical soil structure. Consequently, the soil undergoes crusting, and the water filtration, and water and nutrient retention capacity are reduced. The end result

is intensive run-off and erosion;

- (b) In Mondulkiri province, sheet erosion can be seen as silt which has collected behind cut logs and stumps in the fields, while rill erosion occurs in some fields only three months after clearing and burning the forest for farming. When that occurs, the actual amount of top soil being lost, measured from the top of the remaining grass and tree stumps to the soil surface, is an estimated 1 to 1.5 cm. The fact that rill erosion has already begun in some places suggests that the yearly top soil loss is very serious. Farmers have reported that yield decreases about 20-25 per cent in the second year of cultivation, and about 40-50 per cent in the third year onwards. Soil loss through erosion can be observed at coffee and *hevea* farms where the natural vegetation cover has been completely cleared, leaving the soil surface uncovered between the rows of young seedlings.

Erosion occurs not only in the upland areas but also in the lowland areas. In practice, water run-off occurs on all land, and the top soil is lost when no protective and conservation measures are in place. In Cambodia, however, few people understand that erosion is a serious problem in the rainfed lowland areas. In addition, population pressure in the rainfed lowlands is triggering a chain of events which will lead to intensive run-off, erosion and a reduction in the groundwater recharge. Those events include:

- (a) Excessive collection of fuelwood from woodland and forest areas;
- (b) Overstocking and overgrazing (although the number of animals is increasing, the fodder supply is decreasing);

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- (c) Increased run-off of water from ricefields. Because dikes in some areas, for example, in Svay Rieng, are not high enough to contain rainwater, the run-off contains a great of nutrient.

(b) *Sedimentation*

Increased sedimentation is the consequence of intensive erosion. The recent floods in Cambodia, especially in 1991, 1994 and 1996, have been linked to deforestation associated with increased erosion, run-off and decreasing lake- and river-bed levels. The increased sediment load can also disturb aquatic life, which is the most important animal protein source for Cambodia. That situation is getting worse since many parts of flooded forest and wetland ecosystems, which filter out silt and function as habitats for fish, have been destroyed in the past two decades. Data on sedimentation reveal that the sediment load in the rivers is increasing. In 1996 the maximum sediment load in the Tonle Sap River, which flows from the Mekong River into the Tonle Sap Lake during the monsoon season, was almost two times higher than in previous years (the maximum sediment load was 3,000 g/m<sup>3</sup> compared with 1,500/m in 1994 (Phnom Penh Water Supply Authority, undated). In the Stung Sanke River, in Battambang, the sediment load increased from 63 mg/l on 17 October 1963 to 288 mg/l on 31 October 1995 was 288 mg/l.

The irrigation network in Cambodia has also been adversely affected by the siltation problem. Increasing siltation is believed to be one of the main causes for the unusual flooding which occurred in southern and western provinces in August 1994. The capacity of many irrigation canals, coupled with poor maintenance, has been considerably lowered by embankment erosion and excessive siltation. In many canals the siltation situation has become so serious that farmers have started to grow rice along the canal beds.

(c) *Land productivity*

The average rice yields in Cambodia over the past five years have been relatively constant, varying between 1.2 and 1.3 tons/ha in the monsoon season and 2.5 to 2.7 tons/ha in the dry season. During 1995/96 a considerable increase in rice yield was recorded: 1.64 tons/ha in the monsoon season and 3.0 tons/ha

in the dry season (Ministry of Agriculture, Forestry and Fisheries, 1995). That rise in yield has been linked to good weather conditions, increased use of fertilizer and the expanding cultivation of high-yielding varieties in the dry season<sup>1</sup>. For other important secondary crops the yield has remained relatively constant. The average yield of cassava is 6.61 tons/ha, sweet potatoes 4.16 tons/ha, mung beans 0.78 tons/ha, sugar cane 27.29 tons/ha and soybean 1.07 tons/ha (Ministry of Agriculture, Forestry and Fisheries, 1995).

Soil fertility depends on the agro-ecosystem. There are four important rice agro-ecosystems in Cambodia: rainfed lowland rice; rainfed upland farming; deep-water or floating rice; and dry-season (mostly flood recession) rice. While declining soil fertility is increasingly affecting the rainfed lowland agro-ecosystem, the soil fertility in the other systems can be restored through yearly siltation or through the clearing of forest areas. Unfortunately, the rainfed lowland agro-ecosystem is the most important in Cambodia because that area covers about 85 per cent of the cultivated area of the country. Rice in that ecosystem is commonly grown on Ultisols and Alfisols (Reyes and others, 1995). Those soils, especially Ultisols which comprise the most common rainfed lowland soil, are sandy, acidic, extremely infertile and low in organic carbon and cation exchange capacity. The rainfed lowland areas are badly degraded, especially where land settlement has continuously occurred over hundreds of years (for example, Oudong in Kampong Speu province, and Bati in Takeo province). In those areas, the soils are very sandy and the top soil has been seriously depleted or eroded.

(d) *Salinity and waterlogging*

Rising salinity has become a major environmental problem in irrigated areas of many tropical countries. In Cambodia that problem is, however, not serious at present. Nevertheless attention should be given to the issue, since a rising trend in salinity exists in many parts of the country, according to the following indications:

- (a) Reports that some farmers, because of a lack of capital, use sea salt as fertilizer. The average amount of sea salt used varies from

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<sup>1</sup> Area under IR rice cultivation in 1995 was two times higher than in 1994 (Department of Agronomy).

- 70-100 kg/ha (Somnea, 1995);
- (b) Farmers in some parts of the country have been using groundwater to irrigate their rice-fields during the dry season. During discussions with farmers in Prey Kabas (Takeo province), the majority reported that after two or three years the soil had become white and salty, and that rice growth had been disturbed or the crop had died;
  - (c) Lowland paddy soil has reportedly been affected by salinity and sodicity. Fifty per cent of the soils observed during the Partnership for Development in Kampuchea soil survey in Kampong Speu province were reported to be sodic below 30 cm (Halcrow, 1994a);
  - (d) There are also indications that at specific locations of irrigation systems, particularly in the southern provinces, there are sodium associated clays which are dispersive (Halcrow, 1994b);
  - (e) The loss of mangroves in Kampot province has resulted in salt-water intrusion in rice-fields (Guy, 1995).

The problem of waterlogging has also been observed, particularly in the late monsoon season (September and October) when heavy and prolonged rainfall occurs.

Waterlogging associated with flooding occurs in many rice-growing areas, where a chessboard pattern irrigation system was constructed during the Pol Pot regime. Under that system, canals were dug at intervals of 1 kilometre and small ricefields were combined into fields of 1 ha. Such a system accelerate drainage from higher areas and prevents drainage from lower-lying areas, leading to waterlogging and flooding in lower-lying fields.

In Cambodia waterlogging is the main constraint on growing secondary crops in upland fields and home gardens during the latter part of the monsoon season. To find appropriate techniques for farmers to grow vegetables and other non-rice crops in the late monsoon season period remains one of the main challenges.

(e) *Rehabilitation*

The problem of soil degradation is becoming a major threat to the sustainability of the farming system in Cambodia. Nevertheless, not much attention has been given to soil rehabilitation. In terms of improving soil fertility, the Ministry of Agriculture is more interested in better use of mineral fertilizers.

At present some non-governmental organizations (NGOs) are working on soil and water conservation, including agroforestry, watershed management, green manure cropping, mulching and compost. For example, the JVC training and extension programme gives soil erosion control and watershed management as one of its priorities. Coopération Internationale Pour le Développement et la Solidarité (CIDSE) is aware of nutrient run-off and erosion problems, and encourages farmers to construct high rice dikes to prevent nutrient and topsoil loss (Sopheha, 1995).

In general, soil improvement in Cambodia has been practiced through increased use of mineral fertilizers. Soil conservation and watershed management are in the initial stages and it will take some time until such practices can be adopted by the government.

## 2. Environmental impact of pesticide and fertilizer use

(a) *Fertilizer supply and demand*

Until recently the rate of fertilizer consumption in Cambodia was one of the lowest in Asia. From 1980 to 1994, on average, about 31,000 tons of fertilizer were imported annually (Cameron, 1995). Since 1991, private sector imports of fertilizer have been officially allowed. In 1995, it has been estimated that 75 per cent of the fertilizer supply came through private traders and 25 per cent through the State corporation Compagnie Centrale des Matériaux Agricoles (COCMA). As a result of the increasing role of private companies in the import and distribution of fertilizer, trading is spreading very fast in the country. It has been estimated that in 1995 some 80,000 tons of fertilizer was used (Cameron, 1995), rising to a projected 100,000 tons in 1996. In the year 2000, fertilizer demand is projected to be 200,000 tons (Ministry of Agriculture, Forestry and Fisheries, 1996a). Based on discussions with traders, it can be

confirmed that the supply of fertilizer is increasing, not only because there are a growing number of traders but also because the amount of fertilizer sold has remained the same or increased. In addition, a growing number of farmers are using fertilizer, since funds are available through loan programmes provided by NGOs and international organizations.

On average, during 1995, fertilizer consumption in Cambodia was approximately 40 kg/ha<sup>2</sup>, compared with 3 kg/ha in 1965<sup>3</sup>. Fertilizer consumption, however, differs widely among the various agro-ecosystems. In the rainfed lowlands of Cambodia, fertilizer is not applied to all fields<sup>4</sup> and the application rate varies between 15-200 kg/ha (the standard rate is 50-100 kg/ha). Investment in fertilizers by farmers depends on the water supply. In a bad season, fertilizer will be not applied except for small amounts to nursery beds. In the flood recession and dry season periods, agrochemicals are utilized for all irrigated rice and commercial vegetable production. An application rate of 200-300 kg/ha is becoming standard in Prey Veng and Takeo provinces. The most widely used fertilizers among farmers in Cambodia are urea, diammonium phosphate (DAP) and 16.20.0.

(b) *Misuse of fertilizer and other problems*

Agrochemicals have been widely adopted by farmers in Cambodia. Nonetheless, farmers still consider organic manure to be very important, since it helps to improve the soil structure and fertility. Farmers are aware of the advantages of the combined use of both types of fertilizer.

<sup>2</sup> The Food and Agriculture Organization of the United Nations recommends the following rates (N-P-K in kg/ha): For wet-season rice between 40-23-0 and 40-23-20; and for dry-season rice from 44-25-0 to 80-57-0.

<sup>3</sup> In comparison, fertilizer consumption in 1995 in Thailand was 54 kg/ha. In Viet Nam it was 136 kg/ha, in China, 282 kg/ha, the People's Democratic Republic of Korea it was 345 kg/ha and in developing Asia, 114 kg/ha (Agro-Chemicals, 1995).

<sup>4</sup> The Cambodia-IRRI-Australia Project survey in 1993 revealed that fertilizer was not applied to about 50 per cent of the land. According to a government survey, about 78 per cent of the 28 farmers interviewed in Kampong Speu province and 35 per cent of the 47 farmers interviewed in Kandal province had applied fertilizers to their fields in 1995.

The rapid increase of fertilizer supplies and their use in Cambodia, however, can result in a number of problems, and agronomists are beginning to become concerned. The most likely problems are detailed below:

- (a) Farmers do not use fertilizer at either the appropriate time or in the right amounts. There is a trend towards overuse of fertilizer, especially in the dry season, and this raises a problem of economic efficiency since the farmgate price of paddy in that season drops by about 20 per cent<sup>5</sup>;
- (b) The efficiency of fertilizer comes into question, since farmers can not control water (during flood or drought). It has been reported that soil has become harder after the increased use of fertilizer in rainfed rice-fields. In that context, it is becoming very important for a systematic study on the efficiency and environmental impact of fertilizer;
- (c) There are indications of increasing dependency in the farming system on external inputs. Many farmers who have started using agrochemicals now have to use it every year, often in the increasing rates;
- (d) The problem of adulteration sometimes occurs because the nutrient content of the fertilizer does not always comply with that indicated on the label.

(c) *Pesticide supply and demand*

Throughout Cambodia the pesticide market is rapidly expanding and pesticides are increasingly believed to be the main contributor to increased productivity and food production. Since the government introduced the free market economy

<sup>5</sup> In 1996, flood recession rice farmers in Takeo and Prey Veng provinces produced a large rice surplus (high-yield variety). They complained that the price for their produce was very low and that they experienced difficulties to find markets (see also *Raksmei Kampuchea*, 23 June 1996). In 1995 the price was more than CR 4,000 per tao (12-14 kg), but in 1996 it fell to around CR 3,500.

following the United Nations Transitional Authority in Cambodia (UNTAC) period and the national elections held in May 1993, pesticides have been increasingly imported by private traders from Viet Nam and Thailand. In the absence of government import regulations, there are no data available on the supply of pesticides in Cambodia. However, according to data from the Plant Protection Office, the amount of pesticides distributed in Cambodia from 1985 to 1993 varied between 23,128 and 73,762 l/kg per year (the annual average is 45,740 l/kg). One survey revealed that there were 30 pesticide products (according to trade names) available on the market, of which insecticides made up 73 per cent, followed by herbicides (9 per cent), rodenticides (36 per cent), fungicides (6 per cent) and others (6 per cent) (Polo, 1994). The Cambodia-International Rice Research Institute Australia Project (CIAP) national survey showed that the most commonly available pesticides are Parathion-methyl (Ia)<sup>6</sup>, Mevinphos (Ia), Endrin (Ia), Dichlorvos (Ib), DDT (II) and Malathion (Jahn, 1996).

(d) *Pesticide use*

Insecticides are the most commonly toxic agent used in the different agro-ecosystems of Cambodia. The intensity of their use, which depends on the cropping system, is heavily concentrated in commercial vegetable and dry-season rice production, which together make up only about 10 per cent of the total cultivated area (Ministry of Agriculture and Fisheries, 1995). Generally, only a minority of farmers apply insecticide to their fields in the monsoon season. The results from interviews with 100 farmers in Kampong Cham province indicated that 16 per cent used insecticides in the monsoon season, while 88 per cent used insecticides in the dry season (Jahn, 1996). In commercial vegetable growing all farmers used pesticides.

Although a wide range of pesticides is available, generally only five types have been found to be used by farmers. According to Chatterjee (1995), the five are Methyl Parathion, Mevinphos, Metamidophos, Monocrotophos and zinc phosphide. On rice,

especially wet-season rice, farmers generally use only Methyl Parathion (known as Folidol). Folidol is also widely used for water melon, which is an important cash crop for rainfed lowland farms. In general, vegetable farmers prefer to combine three to six different types of pesticides in order to increase effectiveness.

(e) *Problems and concerns with pesticide use*

It appears that pesticides have been widely adapted and are being used increasingly by Cambodian farmers. That trend suggests that toxic chemicals are becoming a major threat to human health and the environment, since farmers commonly use extremely toxic insecticides without appropriate protection or knowledge of the impact on their health and the environment.

Some of the major concerns related to pesticide use in Cambodia<sup>7</sup> are:

- (a) Most pesticides available and commonly used are very hazardous to human health;
- (b) Most pesticides are harmful to aquatic life such as fish and frogs which are the most important sources of protein for the poor in rural areas;
- (c) Most agro-pesticides are broad spectrum; they kill not only the target pest but also beneficial insects such as predators and pollinators, thus leading to pest resurgence;
- (d) There is a high risk of pesticide residue remaining in food because the period between harvesting and use is very short;
- (e) Inadequate repacking and sale of expired pesticides as well as adulteration;
- (f) Pesticides pollute shallow wells and ponds, which are the main sources of drinking water in rural areas;
- (g) Misuse of pesticides is common since farmers do not distinguish between different kinds of

<sup>6</sup> The numbers in parenthesis are the World Health Organization classification of pesticides. Ia means extremely hazardous, while Ib is highly hazardous, II is moderately hazardous and III is slightly hazardous.

<sup>7</sup> Based mainly on Chatterjee (1995 and 1996).

pests and diseases.

Several attempts have been made to encourage farmers to employ alternatives to pesticides. The Department of Agronomy, with support from international organizations and NGOs, has been providing training for government officials and rice farmers in IPM.<sup>8</sup> Some NGOs are also working on educational campaigns and are encouraging farmers to practice ecological farming. The Ministry of Environment, through the Cambodian Environment Management Project which is funded by the United States Agency for International Development, is also working on pesticide education for farmers.

(f) *Regulations for fertilizer and pesticide use*

Before 1991, the import and distribution of agrochemicals was the monopoly of COCMA. Fertilizer was distributed directly to farmers through the local authorities. At present, the import and distribution of fertilizers and pesticides are being increasingly dominated by private traders. In addition, fertilizers imported through COCMA have been increasingly sold directly to private traders.

The entry of private traders into the market has made the distribution system more effective, since agrochemicals are widely available in local markets; however, it has also resulted in the import and sales of low quality or substandard produce. Quality control does exist in Cambodia, but it mainly serves as a source of information on the quality of produce. There are no regulations governing the import and use of agrochemicals.

### **3. Deforestation**

(a) *Current statistics on the rate of deforestation*

In 1964, forests in Cambodia covered an estimated 13,220,000 ha, which amounted to 73 per cent of the total area of the country (Tichit, 1981).

Following the start of the civil war in 1970, deforestation increased rapidly. Based on a satellite map of Cambodia made in 1992 and 1993, the forest cover remained at 62 per cent.

Since 1992, the annual deforestation rate has escalated sharply. That trend prompted the government to impose a ban on tree felling on 1 January 1995, followed by a ban on cutting and exports ban on 30 April 1995. Three months later, however, the government lifted the ban on exports to enable companies to sell trees cut before 30 April 1995 as well as to facilitate the seizure of timber from illegal loggers. A new export ban has been in force since 31 December 1995.<sup>9</sup>

(b) *Major factors causing deforestation*

Important factors which have contributed to the reduction of forest cover in Cambodia are: logging, expansion of agriculture land, tree felling and burning during the war, fuelwood collection, shifting cultivation, mining in Battambang province, shrimp farming and commercialization of forestry products.

(c) *Replanting and reforestation efforts by the government*

Since 1985, the Department of Forestry has been implementing tree planting and reforestation programmes in those provinces with forest cover of less than 10 per cent. A number of NGOs later became involved in the reforestation programmes (for example, Concern Worldwide in Kampong Chhnang, the Mennonite Central Committee in Takeo and Santi Sena in Svay Rieng). In cooperation with NGOs, the Department of Forestry is also promoting community forestry in some parts of the country.

### **4. Water for sustainable food production and rural development**

(a) *Extent of irrigation systems*

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<sup>8</sup> In general, the National Integrated Pest Control Programme has targeted only rice farmers, and not vegetable farmers.

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<sup>9</sup> *Cambodia Times*, 26 August 1996.

*on agricultural land*

According to Ministry of Agriculture, Forestry and Fisheries (1995) agricultural statistics, 82 per cent of the rice cultivated in Cambodia is grown in the monsoon season under rainfed conditions with supplementary irrigation, 6 per cent is grown as floating rice and about 2 per cent through shifting cultivation. About 10 per cent is grown during the dry season, mostly as flood recession rice with supplementary irrigation. It has been estimated that 16 per cent of the total paddy cultivation area is irrigated, but that only 1 per cent is fully irrigated in the dry season (Ministry of Agriculture, Forestry and Fisheries, 1996a and 1996b).

The most common irrigation techniques include: traditional lifting, mobile pumping station, gravity, or a combination of those methods. Treadle pumps have also been introduced by several NGOs.

Large-scale irrigation systems with canals and control structures do exist in Cambodia. There are 841 existing irrigation systems, covering a total area 171,727 ha, 69 per cent of which were built during Khmer Rouge period from 1970-1975 (Halcrow, 1994a). Such development was made possible during that time because the Khmer Rouge forced the population to dig the canals and construct the reservoirs.

As a result of the absence of maintenance all the systems have deteriorated and some can only function at a low level of efficiency. With support from the government and a number of organizations, a few irrigation systems have been rehabilitated. Only 21 per cent of the existing systems have been reported as fully operational (Halcrow, 1994a).

*(b) Contamination of water supplies*

Drinking water supplies in the rural areas are believed to be contaminated with human excreta, which causes frequent outbreaks of water-borne diseases. Those diseases are among the leading causes of child morbidity and mortality. In some areas, groundwater from drilled wells contains very high levels of minerals. Over-pumping of groundwater from tubewells can contaminate the soil through saline intrusion. There are also risks of water pollution from excessive use of fertilizers and pesticides.

The quality of water supply in the urban areas is very low, since leakages occur as a result of old and decaying pipes and illegal connections. The quality of water in urban areas cannot be guaranteed further than 100 metres from the treatment plant.

Pollution of river water in Cambodia has not yet become a serious problem. But with the growth of the economy and the introduction of high external input agriculture, there is a risk of water pollution from the increased use of agrochemicals, dumping of urban sewage, untreated factory wastes and an increasing number of motorized boats. That will not only have an impact on the drinking water quality but will also reduce yields of fish, shrimps, crabs etc.

**5. Inland fisheries**

Rice farming and fishing have traditionally been the most important activity of rural Cambodians, with the latter resource providing 40-60 per cent of the protein intake (Ministry of Agriculture, Forestry and Fisheries, 1996b).

Flood recession rice production in the dry season has been given priority in order to ensure food security and promote exports. Although dry-season rice is profitable, its expansion and intensification need to be monitored carefully. Uncontrolled expansion at the cost of inundated forest, increasing (mis)use of agrochemicals and the risk of fuel and oil spills in water can have a negative impact on the fisheries ecology. That ecological perspective should be adopted in development policy in order to avoid a conflict of interests between farming and fishing communities.

In 1995, the inland fish and marine catches totalled 72,500 and 7,300 tons, respectively (Ministry of Agriculture, Forestry and Fisheries, 1995). Current official data on the inland fish catch are underestimated, because the catches by thousands of families and subsistence farmers are not recorded (Ahmed and Tana, 1996). Moreover, the catch obtained from ricefields by farmers in the rainfed lowland areas have been never included. Wild fish and other aquatic produce collected from ricefields provide the most important source of animal protein for rice farmers. Under good environmental conditions the annual yield of wild fish from ricefields can exceed 50 kg per family.

There is no clear evidence concerning the decline in fish production. However, there are indications that the fishery sector is under threat as a result of the loss of flooded forest areas which are fish spawning habitats, destructive fishing practices, increasing pressure on fishing grounds through population growth and expanding commercial exploitation, the disturbance of aquatic life by worsening erosion and siltation of rivers and lakes, and the intensification of agriculture through increased use of chemical fertilizers and pesticides.

Although government legislation exists, illegal fishing is common. The most destructive practice is fishing from June to September, which is the spawning season. Baby fish are caught and mainly exported to Viet Nam.

### **6. Improving farm production and farming systems through diversification, non-farm employment and infrastructure development**

Traditionally, farmers in Cambodia have various sources of livelihood, ranging from rice farming, vegetable and fruit cultivation in home gardens, other non-rice crop cultivation in upland areas, animal husbandry and fishing. Fuelwood and wild vegetable collection play an important economic role in the livelihood of rural families.

Livestock has very important function in the farming system. Cattle and buffaloes provide most of the draught power and the manure used to fertilize crops. In addition, they are an important social asset for the rural population. In the last 10 years, the cattle population has increased from 1,560,000 head in 1985 to 2,770,000 in 1995 (Ministry of Agriculture, Forestry and Fisheries, 1995 and 1996c). The total number of buffaloes and cattle in Cambodia is estimated to be 3,540,000 but they are concentrated mainly in the rainfed lowland areas. Chickens and pigs are increasingly being raised by the rural population. From 1984 to 1994, the number of pigs was estimated to have increased by 100 per cent and poultry by 85 per cent (Ministry of Agriculture, Forestry and Fisheries, 1996b). Currently, there are approximately two million pigs and 10 million chickens in the country (Ministry of Agriculture, Forestry and Fisheries, 1995).

Despite the positive trend in animal husbandry, the sector is facing constraints. The most serious

constraint is disease, with a mortality rate of 50 per cent among chickens and 30-40 per cent among pigs (Ministry of Agriculture, Forestry and Fisheries, 1996a). Another constraint is the lack of fodder supplies, especially in the dry season, which limits cattle and buffalo production. In the dry season, rice straw is the most important fodder source; however, it has a very low nutritional value. Even during the monsoon season the fodder supply remains poor, because the grazing area is small compared with the number of livestock. As a result of poor management, community land is heavily overgrazed and degraded. Another limitation is that the government has only been implementing vaccination programmes to promote the development of the livestock sector, and has not considered the problem of fodder supply.<sup>10</sup>

Family-based aquaculture is slowly developing. A number of NGOs are promoting integrated farming systems such as aquaculture with vegetable crops, and livestock and rice-fish farming.

Non-production activities such as collecting fuelwood, vegetables and other non-timber forest products are also very important for the rural population. Because of the degradation of forests, particularly in the rainfed lowlands, farmers are increasingly facing fuelwood shortages. Except for a few agroforestry projects implemented by NGOs, the programme to improve fuelwood supplies through family and/or community-based woodlots has not been widely carried out.

#### *(a) Non-farm employment and rural credit*

There are no accurate statistics on non-farm employment in Cambodia. But, in general, non-farm income is becoming a major source of revenue for the farming community. According to the 1993 Social and Economic Survey of Cambodia, agriculture income accounts for only 43.5 per cent of total income. It appears that farm income is very low but that figure might not include income from other non-productive activities, such as fuelwood, vegetable and water

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<sup>10</sup> Using international funding, a programme to promote better use of local available fodder resources is being implemented. However, the programme focuses more on feeding pigs with palm sap and aquatic weeds.

collection, and fishing for family consumption. Nevertheless, income from non-agricultural source is rising. Increasing population pressure associated with the marginalization of landholdings and the depletion of natural resources in the highly populated lowland areas has forced farmers to find alternative sources of livelihood in the non-farming sectors.

A total of 31 organizations, mainly NGOs, are providing rural credit services, but those services only meet the needs of 3.5 per cent of the rural families (Dauban and Tea, 1996). Currently, the rural credit policy emphasizes income-generating activities in the rural area.

#### (b) *Roads*

The total length of national and provincial roads is only 7,800 km (not including district and village roads) in a country of 181,035 km<sup>2</sup> (Ministry of Agriculture, Forestry and Fisheries, 1996b). With the exception of some national roads which have been rehabilitated and upgraded with international funding, the majority of roads are still in poor condition.

Through the Food for Work Programme, which is being implemented with assistance from the World Food Programme, some district and village roads have been rehabilitated or constructed. However, transportation and market constraints continue to limit the movement of commodities from areas with production surpluses to areas with deficits. As a result, a big food price gap is common.<sup>11</sup>

#### (c) *Research and extension*

Cambodia has no national research system and no focused research institutions. The Department of Agronomy has its own research stations and a development centre. However, the research activities and extension work are poor and limited, and can only be fully operated when there is support from CIAP and NGOs. Research and extension activities of the Department of Animal Health and Production are also poorly organized. With the support of the

Church World Service (CWS, 1995), a National Veterinary Diagnostic Laboratory has been established to do diagnostics work, research and training.

At the community level there are no agricultural agents, because they had to resign as a result of a lack of funding by the government. Most of the training and extension activities at the grass-roots level are carried out by NGOs, in some areas with the cooperation of district agricultural agents.

At the district level, the agents focus mainly on collecting information about cultivated, harvested and damaged areas. In addition, they regularly cooperate with CIAP in promoting modern rice varieties and in making recommendations to farmers on fertilizer use. Extension work in animal husbandry has mainly focused on vaccination.

## **B. Agricultural policies on sustainable development**

### **1. Government policies and planning**

#### (a) *Increasing and stabilizing production*

##### (i) *Irrigation and water management policies*

Irrigation has been made a national priority, and emphasis will be placed on participation by the people and small-scale irrigation. However, the issue of groundwater irrigation has not been addressed by the Ministry of Agriculture, Forestry and Fisheries. Although this system has not been widely adopted, there is a high risk of groundwater misuse because of the lack of information.

##### (ii) *Agricultural inputs*

Fertilizer is considered to be an important factor in increasing rice yields. In addition, the promotion of high-yielding rice varieties will continue. The private sector will be supported in providing the services required by farmers. The government also planned to introduce laws on agrochemicals in 1996. Although IPM will be included, no clear position has been taken

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For example, there is a price gap of US\$ 160 per ton for rice between Takeo province and Phnom Penh (Cameron, 1996).

on the use of pesticides. Likewise, other soil improvement measures have yet to be addressed and a clear programme does not exist for improving the rainfed lowland production systems. The majority of rainfed lowland farms are unable to take advantage of fertilizers and high-yielding varieties because the farmers lack control over water. In addition, rainfed lowland soils have a low nutrient holding capacity.

The absence of government regulations on imports, production and distribution of agrochemicals combined with poor extension services may lead to increasing availability and use of the most dangerous agrochemicals. Ultimately, and the farmers will be the losers.

(b) *Programme to improve socio-economic conditions and extension services*

The non-availability of credit is considered to be a major constraint on development. Currently, rural credit services are provided through NGOs or in cooperation with NGOs and international organizations. In addition, a programme exists for placing village banks under the regulatory framework of rural credit banks.

So far, research and extension activities have been limited. The newly established Department of Agricultural Technology and Economics Extension is in the process of training its staff and its activities depend heavily on international funding.

The Ministry of Agriculture, Forestry and Fisheries has acknowledged that marketing services have been poor. But the Ministry is determined to improve marketing and will seek support from international community in achieving that objective. The absence of improved marketing will result in decreasing net profitability, and farmers will not be motivated towards increasing production. In addition, the big gaps will remain between regions with food surpluses and those with food deficiencies.

(c) *Policies and programmes for facilitating access to food*

The government has targeted the most vulnerable communities through two programmes:

(a) The Food for Work Programme which is supported by NGOs and international organizations, and is coordinated by the Ministry of Rural Development;

(b) Strategies which focus on the reduction of poverty through income-generating activities. Under those strategies, handicapped persons, refugees and internally displaced persons, and female-headed households are being especially targeted. The strategies mainly aim at increasing access to credit and training.

(i) *Diversification*

The government has acknowledged that a high dependence on rice results in an unbalanced diet, and it will therefore assist and promote crop diversification. However, the programme will depend heavily on the granting of a World Bank agricultural productivity loan.

Although the importance of the livestock sector is being addressed, only disease has been identified as a serious constraint on animal production. The fodder shortage, which is holding back livestock production, has been ignored.

(ii) *Fisheries*

The government has yet to address the socio-economic problems of family-level fishermen who are facing limited access to good fishing grounds. Moreover, a programme has yet to be set up to assist or promote family-based aquaculture. The government appears to consider commercial exploitation to be more important than family-based fishing and aquaculture.

(iii) *Agro-processing*

National priority has been given to encouraging companies that are able to produce value added agricultural commodities. In addition, vocational and business management training is to be promoted, but the government has failed to properly address the target group.

(d) *Resource management for sustainable food security*

An indirect link between deforestation and sustainable food security has been acknowledged by the government. Environmentally-linked problems such as deforestation, which results in increased soil erosion, siltation, and widespread and frequent flooding, are beginning to be addressed.

The issue requires strong intervention by the government, since farmers do not have control over the regional environment. But the government is only considered a review of forestry policies and has yet to develop clear programmes and policies on soil and water conservation. The sustainability of farming systems will continue to be threatened by natural disasters and farmers will become increasingly dependent on external food aid.

### **3. People's participation and human resources development**

#### *(a) People's participation*

The sustainability of each development effort depends mainly on how much each community is involved in the development process. In Cambodia, the government generally adopts a relief operation approach and intervention in agricultural production is mainly through the provision of food aid, food for work, seeds, fertilizer and pumping services. Such relief projects are important because some parts of the country continue to be threatened by warfare and natural disasters.

In addition, a number of development projects such as large-scale irrigation have been started. But because of the failure to involve the population and negative past experiences of the Cambodian people with community organizations, it has not been possible to continue the full operation of the irrigation systems after the withdrawal of outside support. The lack of strong community involvement can also be linked to the fact that for 20 years Cambodians had no opportunity to elect their community leaders.

The government now realizes the importance of community participation and will adopt a participatory approach in future development planning, such as irrigation and the Food for Work Programme (Ministry of Agriculture, Forestry and Fisheries,

1996b). In addition, the Ministry of Rural Development has been involved in promoting village development committees.

Although the participation of the people has been addressed, other important issues have been ignored, such as participation in government concessions for logging, plantations and fishing lots, as well as urban and hydropower development plans. The lack of public participation may create a socio-economic crisis for the rural population as they will face limited access to natural resources: water, forest and land.

#### *(b) Human resources development*

Human resources development has been considered a national priority by the government (Cambodia Development Council, 1996). As the result of government efforts and international support,<sup>12</sup> larger numbers of agricultural engineers and technicians have been graduating from the two main institutions, the Royal University of Agriculture of Chamkar Dong and Prek Leap Agriculture College. In addition, various training programmes have been organized with the support of international organizations and NGOs, and many students have graduated from foreign colleges and universities.

The number of trained people working in different government institutions is increasing. For example, the Department of Agronomy has 324 trained officials, of whom 130 received training at higher education institutions.<sup>13</sup> Of the 490 officials in the Department of Animal Health and Production around 60 received training at the Royal University of Agriculture (Chamkar Dong), Prek Leap College or overseas.<sup>14</sup>

It appears that the lack of human resources is not serious. The real problem is insufficient

<sup>12</sup> For example, the French organization, Groupe de Recherche et d'Echanges Technologiques, is providing technical assistance to the Royal University of Agriculture (Chamkar Dong), while the NGO, Australian Catholic Relief, is helping to strengthen Prek Leap Agriculture College.

<sup>13</sup> Department of Agronomy (unpublished data).

<sup>14</sup> Department of Animal Health and Production (unpublished data).

mobilization and motivation of educated people. For security reasons and the possibility to earn extra income, most trained officials prefer to stay in Phnom Penh.

The problem of human resources development is very serious at the Royal University of Agriculture (Chamkar Dong), where the future generation is being trained. Many resource persons are young or newly graduated. They are poorly paid and are therefore not motivated to improve their teaching abilities. Teaching quality will remain low or even decline unless the government changes the existing incentive system.

The Ministry of Agriculture, Forestry and Fisheries will continue to face human resources constraints not only from the lack of mobilization, but also as a result of an increasing “brain drain” as more and more qualified people join NGOs, international organizations, private companies etc. So far, however, it has mainly been qualified people or those with good knowledge of one or more foreign languages who have resigned or taken a temporary break from their assignments with the government.

The current government policy has contributed to the increase in the number of trained people. But it cannot lead to improved efficiency of the agricultural institutions, because the trained people have been not fully mobilized and motivated, or given opportunities to improve their skills through clearly defined responsibilities. Consequently, the rural areas will continue to face a lack of human resources and technical assistance.

### **C. Desirable strategies for sustainable agricultural development**

Traditionally, Cambodia’s agriculture is mainly a rice-based farming system. As a result of changing circumstance, including growing population pressure associated with increasing resource exploitation and degradation of the natural environment, the sustainability of traditional agriculture is under threat. Given the country’s priority for achieving food self-sufficiency to meet the demands of a rapidly growing population, there is a definite need to improve the existing land-use system, with due consideration being given to ecologically sustainability and economic

viability. One basic idea is to develop a diversified and integrated system with high productivity and a wide range of food, fibre and fuelwood supplies. In that context, priority should be given to enhancing and sustaining the productivity of rainfed agriculture since the majority of Cambodians depend on it.

The following paragraphs suggest a strategy for sustainable agricultural development by taking into consideration soil and water conservation, diversity and integration, community-based and human resources development, and mobilization-based approaches into consideration.

#### **1. Soil and water conservation practices**

The improvement of rainfed lowland soil is a prerequisite for sustaining and enhancing the productivity of the system. Soil can be improved through better use of organic matter (e.g., compost), green manure and forage cropping. More effort should be directed towards introducing appropriate fast-growing, multipurpose trees/shrubs, as they can provide green mass for use as manure (cut and carry) and fodder. Sustaining soil fertility is much easier in a crop-tree system than in a crop system alone.

Management of water resources should be improved through water harvesting in micro-catchment and small-scale supplementary irrigation (e.g., treadle pumps). With the improvement of soil fertility and supplementary irrigation, rice yields in the rainfed lowlands can be increased with minimal or no mineral fertilizer.

A major challenge is the improvement of the production system in the late dry and late wet seasons. Drought and floods place constraints on growing secondary crops in those seasons. In addition, declining soil fertility, resulting mainly from the loss of top soil, considerably reduces the productivity and stability of the system. Therefore soil and water conservation practices (e.g., increasing vegetation cover, mulching, adding organic matter, planting deep-rooting trees and shrubs, contour planting, using diversion channels and dry trenches etc.) should be encouraged and promoted to prevent soil loss and improve soil moisture content.

To achieve sustainable agriculture, priority should be given to reducing the vulnerability of the farming system to natural disasters. The capacity of

national institutions in monitoring and protecting critical ecosystems and watersheds must be strengthened. There is also a need to introduce soil and water conservation regulations, for example, by prohibiting cultivation and logging on steep hillsides. Some critical ecosystems have been degraded or destroyed, particularly during the Khmer Rouge period, and need rehabilitation.

Many irrigation systems that were design and constructed during the Khmer Rouge period have actually contributed to recent flooding in many parts of the country. Therefore, those systems urgently need modifying or rehabilitation. That will require direct involvement of the communities concerned as local residents can provide information about the impact of the irrigation system and can contribute considerably to its maintenance.

*(a) Diversification and integration*

Integrated farming should be promoted to improve the productivity of multipurpose paddy fields which provide a wide range of agricultural products and which require low external inputs. In addition, more efforts should be directed towards screening the performance of crops in a mixed system. Development and research should focus more on the integration of crops, trees, livestock and fish to ensure positive interaction and an increase in productivity.

Varietal improvement is necessary, but more effort should be made to select crops and fruit trees that are appropriate for each ecosystem and season. In the case of rice, research should focus on improving varieties for cultivation under rainfed conditions.

Animal husbandry, particularly small animals, should be promoted by improving fodder supplies during the dry season and by introducing alternative fodder like corn, beans, aquatic weeds, roots and tuber crops. In addition, more effort should be directed towards improving the vaccination services. Family based aquaculture, which has been promoted by a number of NGOs, needs greater promotion and support.

Rainfed lowland farms are facing ever-decreasing supplies of fuelwood and fodder. Degraded forests and scrubland should be rehabilitated or reforested. That type of land can be used as woodlots

for fast-growing trees or as community forests. The rehabilitation of degraded forests will not only provide a wide range of produce for farmers, it will also restore the ecological balance of the agro-ecosystem. In order to support such a programme, The government and non-governmental agencies should identify appropriate local tree species and cultivate them in mother-tree orchards to produce seeds for existing government nurseries or for distribution to the farmers.

*(b) Regulation of agrochemicals*

In terms of human health and long-term food security, regulations are needed for banning the import, production and distribution of extremely toxic pesticides (mainly class I). In addition, moderately hazardous pesticides (class II) which are highly toxic to aquatic organisms should be restricted. In addition, quality control for fertilizers, seeds and other agricultural inputs should urgently be carried out.

*(c) Ensuring social equity and people's access to land, water and forest*

Government policies should focus on the gradual reduction of commercial fishing activities and the release of more areas for family fisheries. Foreign investment should be promoted but not at the cost of community access to natural resources. The government should recognize the rights of the local communities and give them the opportunity to participate in decision-making regarding concessions for the management of natural resources (e.g., logging, commercial plantations, shrimp farming, fishing lots and hydropower projects).

*(d) Capacity-building by government institutions*

Priority should be given to human resources mobilization rather than only human resources development. Incentive systems should be introduced and opportunities given to young Cambodians for developing their skills. In addition, monitoring, prohibiting and enforcement capacities should be strengthened. In the interest of structural sustainability, international assistance should be focusing more on the reform of institutions to enable them to make more efficient contributions to the development of

agriculture. Instead, however, many international organizations prefer to run their own projects and then hand them over to the government. Without reform of the existing system, structural sustainability after the withdrawal of international assistance or the initial investment becomes questionable.

(e) *Ensuring land tenure security*

Improvements in issuing title deeds for cultivated land and community land will encourage farmers to invest in sustainable agricultural practices as well as conserve and rehabilitate community land. But this programme can only be carried out through improving the capacity of the Department of Land Titling and with community participation. In addition, there is a need to create a framework within which communities can plan and manage their resources.

(e) *Research, training and extension facilities*

programmes to facilitate farmer-to-farmer exchanges should be supported. Innovative farmers need to be identified

and encouraged to conduct or lead field trials and demonstrations.

Sustainable agriculture development in Cambodia will remain a difficult task for the foreseeable future. However, if immediate action is taken by the government together with the international organizations to reform and strengthen national institutions, and if an ecosystem- and community-based approach is adopted in agriculture policies, the increasing food demands of Cambodian society can be met without destroying the natural base.

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In order to support sustainable agricultural development in Cambodia, there is a need to organize system-focused research institutions and encourage initiatives which increase communication and information exchange within and between relevant institutions. In addition, the government should establish a national agricultural research system.

For higher education and training institutions, a curriculum based on a pragmatic and systematic approach should be developed and introduced. The government should approach NGOs and international organizations for greater involvement in human resources development by giving students the opportunity to gain field experience at project sites.

The capacity of extension services at the community and district levels should be strengthened. Initiatives for organizing demonstration sites and field trials should be encouraged and supported.<sup>15</sup> In training and research programmes, local knowledge of natural resources management and agriculture should be assessed, recorded and documented. Moreover,

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