



## Recommendations for improved sustainable use of priority Neglected and Underutilized Species NUS in Cambodia



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**Front cover picture:** Mung bean (*Vigna radiate*)

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## **1. General recommendations for NUS in Cambodia**

### ***1.1. General policy issues***

The development of the agriculture sector has been an important element of the Royal Government's strategy to reduce poverty in rural communities, achieve food security, and foster equitable and sustainable economic growth. From a poverty eradication perspective, the most important policy-related objective regarding agriculture development is the improvement of household food security. Contributing to this objective and to improving living standards more generally, market-based farming will be enhanced, given that 85 percent of the population lives in rural communities and 75 percent of the poor are farmer-headed households.

Regarding the agricultural sector, the Ministry of Agriculture of Cambodia has set seven specific sectorial goals. They are as follows:

- 1) Food security, productivity, diversification;
- 2) Improve and strengthen agricultural research and extension systems
- 3) Market access for agricultural products;
- 4) Institutional and legislative development framework;
- 5) Land reform (land tenure and land market development and Pro-poor land access)
- 6) Fisheries reform - sustainable access;
- 7) Forestry reform (promote conservation and sustainable management of forests, ensure better management of protected areas)

Even though the Ministry of Agriculture of Cambodia has a large staff, it is not able to mobilize it effectively. Management is weak, many staff member have limited skills and experience, and low salaries are a major disincentive to them. Coordination with and influence over other agencies and stakeholders are limited. For these reasons, the ministry has difficulties in achieving its sectorial objectives. Policy and regulatory frameworks related to agriculture, water resources and other natural resources management (land, forestry, fisheries, protected areas, environment, food safety standard, etc) require strengthening. Weak extension and research capacity in agriculture and water management constrain technical support to farmers, for example in terms of crop production methods suited to water availability in a particular area. As a result, the farmers' knowledge and skills remain low, and they are unable to benefit from technical opportunities. Institutional weaknesses also constrain the distribution and marketing of agricultural products, resulting in unfair trade and unsafe food, for example.

There is at the moment no policy on NUS in Cambodia and most research tends to be on rice-based farming systems and on rubber.

There is a strategy from the Ministry of Agriculture, Forestry and Fisheries (MAFF) to put more emphasis on organic agriculture, including export of certified organic products.

Cambodia has a privileged status regarding export to many countries (zero or low import taxes) including China. The government could promote Cambodian products as chemical free (or green food as in China).

### ***1.2. General communication and awareness issues***

There exist extension workers and field staff to work with farmers. However, in most cases, it is impossible to mobilize many existing staff because of a lack of resources such as fuel for vehicles. There is a lack in facilities (e.g. training centers and demonstration farms) and networks to disseminate technology, and the linkages between research, development and extension are weak. Therefore, extension services are weak overall. As a result, farmers have limited awareness of and access to agricultural and water management technologies, and hence have poor skills in agricultural production and water management.

### ***1.3. Other general issues***

#### **Market**

Most farmers face difficulties in selling their surplus produce at a reasonable price. This is due to weak linkages between producers and markets. On the market side, weaknesses include undeveloped marketing systems, unfair trade, limited wholesaling, and bulking facilities, small-scale transport, information asymmetry among stakeholders, and inefficient product distribution systems. On the production side, weaknesses include low product quality, and unreliable supply to the market. The bulking process and bulk transport of produce normally are organized by entrepreneurs, or communally where there is strong community solidarity. At present, such activities are found only in rice marketing for export by large entrepreneurs.

Export is limited due to high (unofficial) transport and duty-costs. Much of the products are smuggled over the borders with Vietnam and Thailand as raw products, thereby depriving Cambodia of much needed taxes and labor for processing. Many products are only seasonally available (vegetables, fruits) and have to be imported during off-seasons, mainly from Vietnam and Thailand.

#### **Research**

The major constraints to agricultural research and development are the lack of inputs and materials for investment, the limited capacity of human resource and the lack of academic information as well as the lack of a institutional body to coordinate and manage research and development activities.

Only a handful of agricultural research-institutes exist in Cambodia. The largest, the Cambodian Agricultural Research and Development Institute (CARDI) focuses mainly on rice, with some other activities in mungbean, tomato and maize. Kbal koh vegetable research station develops new varieties and produces good quality seeds of tomato, maize, mungbean and some lesser known vegetables. The Rubber Research Institute is mainly conducting research on rubber and rubber-based production systems.

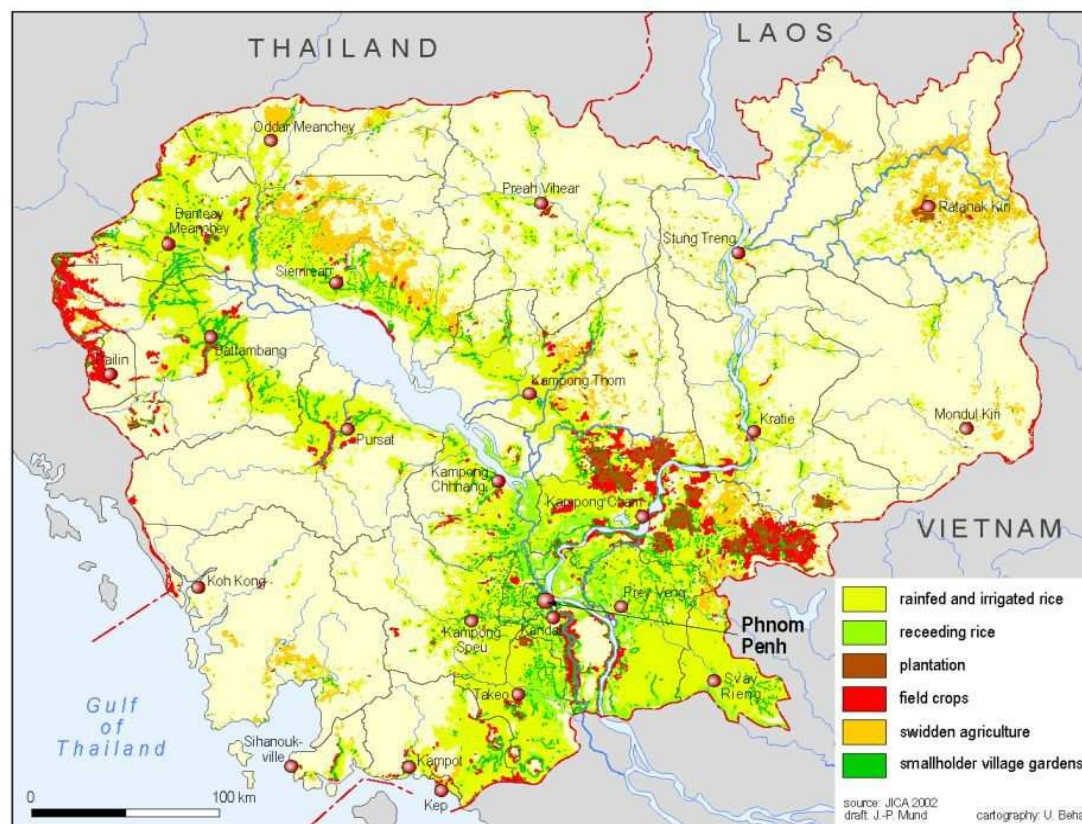
### Land issue

The current agrarian and rural structure in Cambodia may not be suitable yet for a production that is oriented toward market demand and competition. There are many landless farmers in Cambodia (around 400,000) and their number has lately increased. It is difficult for many farmers to secure enough land for their production, while there are many unused lands especially in state land area. The average land holding size is around 1 ha, but most land holders are not entitled to use their land officially. Even land distribution has not yet been realized in Cambodia. Under such insecure land conditions, it is difficult for farmers to invest in their cultivating land, especially for a longer term in perennial crops land, without anxieties. Agricultural land holdings are very limited in size, typically comprising of less than 1.0 hectare and often as little as only 0.5 or less of cropland per household.

### Other NUS

There is a lack of information concerning indigenous crop-species including germ plasm collection and general production information. There is a real possibility that some of these indigenous crop-species could be NUS crops with potential. A general survey could be initiated.

Mushroom cultivation is spreading in Cambodia as there is less need for land and a growing market is available in Phnom Penh and other big cities. Export of certain mushroom-species as fresh or dried products to markets like China would be feasible. However, mushrooms were not considered in this study for Cambodia.



**Figure 1:** Map of Cambodia



## 2. List of selected priority NUS in Cambodia

Scientific name	Family name	English name	Use (1)	Parts used (2)	Type (3)	Life form (4)	Type of NUS (5)
(1) Use: 1: Cereal and pseudocereal; 2: Legumes; 3: Vegetables; 4: Fruits and Nuts; 5: Medicinal, aromatic, stimulant, beverages; 6: Industrial, construction; 7: Forage and browse; 8: Forest trees; 9: Roots / tubers (2) Parts used: 1: Fruits; 2: Grains; 3: Flowers; 4: Leaf; 5: Root or tuber; 6: Stem/ bark; 7: Whole (3) Type: 1: Grass; 2: Shrub; 3: Tree; 4: Climber; 5: Root/ tuber (4): Life form: 1: Annual; 2: Biannual; 3: Perennial (5): Type of NUS: 1: Underutilised species and on FAO list; 2: Underutilised and NOT on FAO list; 3: Neglected							
<i>Arachis hypogea</i>	Leguminosae	Groundnut, Peanut	2,6	2	1	2	2
<i>Piper nigrum</i>	Piperaceae	Black pepper	5	2	3	4	2
<i>Ipomoea batatas</i>	Convolvulaceae	Sweet potato	9	5	2	5	3
<i>Colocasia esculenta</i>	Araceae	Taro	5,9	5	1	1,5	1,3
<i>Zingiber officinale</i>	Zingiberaceae	Ginger	5,9	5	2	5	3
<i>Vigna radiata</i>	Leguminosae	Mungbean	2	2	1	2	3
<i>Nephelium lappaceum</i>	Sapindaceae	Rambutan	4	1	3	3	1,3
<i>Cymbopogon citratus</i>	Gramineae	Lemon grass	5	4	3	1	3
<i>Musa cvs.</i>	Musaceae	Banana	4	1,3	3	2	2
<i>Cocos nucifera</i>	Palmae	Coconut	4,5,6	7	3	3	1,3
<i>Durio zibethinus</i>	Bombacaceae	Durian	4	1	3	3	1
<i>Citrus</i>	Rutaceae	Citrus, Orange	4	1	3	3	1
<i>Anacardium occidentale</i>	Anacardiaceae	Cashew	4	1,2	3	3	1,3



### 3. Special recommendations for selected priority NUS

#### 3.1. Priority NUS 1: *Arachis hypogaea L., Groundnut or Peanut*

<p><b>General Characterization</b></p> <p>Origin: The peanut originated in the area of southern Bolivia and north-western Argentina in South America.</p> <p>Use: Most of the world crop is crushed for oil that is used mainly for cooking. Most of crop in South-East Asia is as such for human consumption.</p> <p>Properties: Per 100g edible portion groundnuts contain roughly: 5.4 g water, 30.4g protein, 47.7g fat, 11.7g carbohydrate, 2.5 g fiber and 23g ash. The energy content averages 2457 kJ/100g.</p> <p>Description: A monoecious prostrate to erect annual herb, usually 15-70 cm high. The root system is consisting of a well developed tap-root with many lateral roots, able to penetrate to depth in excess of 2m; root hairs are absent, nitrogen-fixing nodules present. The main stem or central axis develops from the epicotyls and bears a cotyledon at each of the first two nodes. Branching is dimorphic, with vegetative branches and contracted reproductive branches.</p> <p>Propagation: Commercial crops are grown from seeds. Ideally the seed-bed should be deep and friable with an even particle size, and should be weed free.</p>	
	
<p>Peanut fruits</p>	<p>Peanut plant</p>
<p>Photo source:  <a href="http://commons.wikimedia.org/wiki/Image:Arachis_hypogaea.jpg">http://commons.wikimedia.org/wiki/Image:Arachis_hypogaea.jpg</a></p>	

#### 3.1.1. Policy options

Groundnuts are widely grown in Cambodia, mainly for the internal market and fresh consumption. Yields in Cambodia are quite low compared to neighboring countries. The government should promote small- and medium-scale edible oil extraction for local markets by making this technology available and promote the use of locally processed edible oils (also maize, soybean, coconut and sunflower oils). Almost all edible oils for cooking in Cambodia are imported. A niche-market for organically grown peanuts exists in Singapore and export could be promoted.

### 3.1.2. Research and development options

- Research on varieties (for oil or fresh consumption), edible oil-extraction and processing
- Development of varieties suited to acid soils, screening of germ plasm
- Development or introduction of varieties with suitable characters for export
- Development of seed-production schemes to provide good quality seed-material

### 3.1.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for groundnut cultivation in Cambodia and train extension-workers.

## 3.2. Priority NUS 2: *Piper nigrum* L., Black pepper

### General Characterization

Origin: Pepper is native to the Western Ghats of the Kerall State, India, where it still occurs wild in the mountains.

Uses: The use of the dried product as a food flavoring was already known in classical Rome and Europe was an important importer of pepper as early as in the 12<sup>th</sup> Century. About 80% of the pepper consumption is now concentrated in the industrially developed countries, where it is mainly used for domestic culinary purpose and for flavoring and preserving processed foods.

Properties: Dried pepper contain per 100g edible portion: 9,5-12,0g water; 10,9-12,7g protein; 25,8-44,8g starch; 9,7-17,2g fiber and 3,4-6,0g ash.

Description: A perennial woody climber, up to 10m long or more. In cultivation, mature plants grown on supports may also appear as bushy columns, 3-4 m tall and 1,25m in diameter. Root system with 5-20 main roots, 4 m or more deep, and with feeder roots in the upper 60 cm of soil, which form an extensive dense mat.

Propagation: Most cultivars of pepper are propagated by cuttings. Cuttings can be rooted in a moist medium in a shaded nursery.



Pepper plant

Photo source:  
[http://commons.wikimedia.org/wiki/Piper\\_nigrum](http://commons.wikimedia.org/wiki/Piper_nigrum)

### 3.2.1. Policy options

Black pepper is traditionally grown in the south of Cambodia, in the Kampot province. During the last decade pepper production has been stagnant, mainly due to low world-market prices, occurrence of diseases and limited knowledge on improved culture-techniques. Black pepper processing takes place, but on a limited scale. Some organic pepper is grown in Cambodia, which fetches a high price as an export-product.

### 3.2.2. Research and development options

A main problem in black pepper is the Phytophthora infection.

### 3.2.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for black-pepper cultivation in Cambodia and train extension workers.

## 3.3. Priority NUS 3: *Ipomoea batatas* (L.) Lamk, Sweet potato

### General Characterization

**Origin:** It is generally accepted that sweet potato originated from Central America or the northern part of South America. This acceptance is based on archaeological findings, the distribution patterns of wild species, and variation in cultivated clones.

**Use:** Storage roots of sweet potato are used mainly for human consumption (70-100%) in most tropical countries. Small portions are used as feed (10-30%); neglectable amounts are used for industrial purposes (5-10%). In temperate Asia, 30-35% is produced for industrial purposes, mainly for starch and alcohol. Human consumption of sweet potato in tropical Asia is in the form of dessert snacks or supplementary food, while it serves as a staple food on the island of New Guinea and some Oceanian countries. Young shoots are often consumed as green vegetable. In Cambodia, the young leaves and stalks are consumed cooked as vegetables. The tubers also enter numerous culinary preparations. Eaten raw, they could treat the seasickness. The boiled sweet potatoes are recommended to the convalescents and to the children of the first age. The summit of the stalks of the red variety which, it appears, contains a principle similar to insulin, is administered to diabetics.

**Properties:** Nutritional quality and chemical composition of storage roots are genetically determined, but vary widely in response to various environmental and cultural conditions. Freshly harvested storage roots consist of 16-40% dry matter of which 75-90% is carbohydrate.

**Description:** A perennial herbaceous plant. Root system with fibrous, adventitious roots and enlarged roots, derived from secondary thickening of some adventitious roots, serving as storage organ, variable in shape, size, number, skin colour (white, yellow, orange, purple)

**Propagation:** In the tropics, sweet potato is propagated vegetatively from vine cuttings, but also slips or sprouts obtained as cuttings from storage roots are sometimes used.

Sweet potato plant



Photo source:  
<http://commons.wikimedia.org/wiki/Image:Sweetpotato5162.jpg>

Sweet potato fruit



Sweet potato plant

Photo source:  
[http://en.wikipedia.org/wiki/Image:Ipomoea\\_batatas.jpg](http://en.wikipedia.org/wiki/Image:Ipomoea_batatas.jpg)

### **3.3.1. Policy options**

Sweet potato is grown in many parts of Cambodia. For the moment there is no processing being done.

There is no research on varieties existing.

Some pests attack the roots, causing heavy losses.

### **3.3.2. Research and development options**

- Germ plasm collection and evaluation
- Development of small scale processing facilities
- Research on root-pests and their control

### **3.3.3. Communication and awareness options**

Develop extension guidelines (Technology Improvement Package-TIP) for sweet potato cultivation in Cambodia and train extension workers.

### 3.4. Priority NUS 4: *Colocasia esculenta* (L.) Schott, Taro

#### General Characterization

**Origin:** Taro originated in South-East or southern Central Asia, where it was probably cultivated before rice. Today taro is grown throughout the West Indies and in West and North Africa.

**Uses:** When cooked, taro corms, cormels, stolons, leaf lades and petioles can be eaten. Taro corm puree makes an easily digestible low-allergenic baby food. Waste leaves, corms and peel can be cooked or fermented into silage for animal feed. Most taros in South-East Asia are consumed by humans.

**Properties:** If eaten raw or undercooked, all parts of the plant are acrid and will irritate the mouth and throat, but acidity is reduced or eliminated by cooking and fermenting. Taro is easily digested, practically non-allergenic and has very small starch particles. Per 100g edible portion (fresh) corms contain approximately: 70g water, 1.1 g protein, 26g carbohydrates, 1.5g fiber and 15mg vitamin C. The energy content averages 475kJ per 100g. Leaves contain 4.2g protein. Taro contains protein inhibitors but they are destroyed during cooking.

**Description:** An erect, herbaceous plant growing to a height of 1m or more, perennial, but mostly grown as an annual crop. Root system: adventitious, fibrous, and shallow.

**Propagation:** Farmers propagate taro vegetatively. Corm pieces, whole small corms, cormels and stolons can be planted, but suckers and head-sets (corm apex plus 15-30 cm attached petiole bases) are usually preferred.



Taro fruit

Taro plant leaf



Photo source:

[http://upload.wikimedia.org/wikipedia/commons/c/c2/Colocasia\\_esculenta\\_dsc07801.jpg](http://upload.wikimedia.org/wikipedia/commons/c/c2/Colocasia_esculenta_dsc07801.jpg)

#### 3.4.1. Policy options

Most taro in Cambodia is consumed as vegetable. There is little or no processing.

Some diseases affect the leaves, causing considerable losses.

The local market for Taro is rapidly expanding.

#### 3.4.2. Research and development options

- Germ plasm collection and evaluation
- Development of small scale processing facilities
- Research on diseases

#### 3.4.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for Taro cultivation in Cambodia and train extension workers.

### 3.5. Priority NUS 5: *Zingiber officinale* Roscoe, Ginger, xJI

#### General Characterization

**Origin:** Ginger has been grown in tropical Asia since ancient times. Wild forms of ginger have not been found and its origin is uncertain, although it is thought to come from India.

**Uses:** Ginger is widely used as a spice, with its three main products being fresh ginger, dried whole or powdered ginger, and preserved ginger. Fresh ginger is prepared from immature or mature rhizomes. Fresh ginger is widely used in cooking in South-East Asia, as a flavoring or vegetable and young rhizomes and stem parts are sometimes eaten raw.

**Properties:** Dried ginger rhizomes contain per 100g edible portion: 10g water, 10-20g protein, 10g fat, 40-60g carbohydrate, 2-10g fiber and 6g ash. A high fiber content is undesirable in rhizomes to be used a spice.

**Description:** Erect, slender, perennial herb usually grown as an annual crop, with a thickened, fleshy, subterranean rhizome and with one or more aerial leafy stems, up to 1.25 m tall.

**Propagation:** Ginger is propagated vegetatively by pieces of rhizome called seed pieces or sets. They are normally produced by cutting rhizomes into 3-6 cm long pieces of 30-60g, with at least one growing point or bud. Medium to large-sized seed pieces produce more vigorous plantlets and higher yields than small ones.



Ginger Root



Ginger plant

#### 3.5.1. Policy options

Ginger is mainly produced on a small-scale in traditional production systems. Generally a low yield and no processing are taking place.



#### 3.5.2. Research and development options

- Germ plasm collection and evaluation
- Development of small scale processing facilities

#### 3.5.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for ginger cultivation in Cambodia and train extension workers.

### 3.6. Priority NUS 6: *Cymbopogon citratus* (DC.) Stapf, Lemon grass

<p><b>General Characterization</b></p> <p>Use: Lemon grass is mainly used fresh in Cambodian dishes like soups. The lemon grass essential oil can be extracted through steam distillation which is carried out on a small scale in Cambodia. Lemongrass is also excellent for planting on bunds as soil erosion control and mulch.</p> <p>Plant description: The exact origin of lemongrass is not known but a Malaysian origin is most likely. It is a perennial, aromatic grass with numerous erect culms arising from a short ring-shaped rhizome. Leaves are 50-100 cm long and 0.5-2 cm wide. The inflorescence is a large, nodding panicle, up to 60 cm long. Lemongrass is a strong tillering plant with a rather superficial root system. Only young leaves are suitable for oil extraction. It grows best under sunny, warm and humid conditions below 500 m altitude. Water requirement for a good oil-yield is quite high. It needs drainage and grows best on sandy soils. One hectare can yield 75-250 kg lemongrass-oil.</p>	
Lemon grass fruit	Lemon grass plant
	
<p>Photo source: <a href="http://de.wikipedia.org/wiki/Bild:YosriNov04Pokok_Serial.JPG">http://de.wikipedia.org/wiki/Bild:YosriNov04Pokok_Serial.JPG</a></p>	

#### 3.6.1. Policy options

Lemon-grass is grown widely in Cambodia and can produce year-round leaves. It can grow in regions with low soil-fertility and is therefore attractive for poor farmers in marginal areas.

Essential oil extraction is technically not very difficult and can be done in the communities.

#### 3.6.2. Research and development options

- Research on variety for essential oil-extraction and processing. There is not much data on varieties as well as the effect of soil and varieties on oil-content and – quality.
- Develop low-cost oil extraction technology

#### 3.6.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for lemon-grass cultivation in Cambodia and train extension workers.

### 3.7. Priority NUS 7: *Musa cvs., Yellow, Sugar and Green banana*

#### General Characterization

**Origin:** The exact origin of the edible bananas is unknown.

**Uses:** Fruit is the main product. It is used either raw or cooked, or prepared in another way. It may be processed into starch, chips, puree, beer (Africa), vinegar, or it may be dehydrated. The male buds of some cultivars (e.g. Saba) are used as a vegetable.

**Properties:** Fruits of various cultivars differ in their nutritional composition. At fruit maturity, 100g edible portion contains approximately: 70g water; 1,2g protein; 0,3g fat; 27g carbohydrates; 0,5g fiber. It is rich in potassium (400 mg/100g) and has a special place in diets as it is low in fats, cholesterol and salt.

**Description:** Tree-like perennial herb, 2-9 m tall, with short underground stem (corm) with buds, from which short rhizomes grow to produce a clump of aerial shoots (suckers) close to the parent plant.

**Propagation:** Bananas are generally propagated by suckers. Sword leaf suckers are preferred since they bear larger bunches in the first crop (the plant crop). Corms or pieces of corms (bits) are also used as planting material.



Banana fruit

Banana plant



#### 3.7.1. Policy options

The three banana-species (yellow, sugar and green) are all widely grown in Cambodia, mainly around the house. There are almost no large-scale plantations. Products are consumed locally or transported to larger cities.

Most of the banana products have export potential, especially to China. This would necessitate the establishment of strategically placed banana processing plants, cooled warehouses and the introduction of fast export-procedures.

Organic bananas, especially the sugar (or egg-) banana could enter a niche-market overseas.

#### 3.7.2. Research and development options

- Collection of banana-varieties existing in Cambodia and screening for quality, diseases and yield
- Production of virus-free banana plants for distribution to farmers

#### 3.7.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for yellow banana cultivation in Cambodia and train extension workers.



### 3.8. Priority NUS 8: *Cocos nucifera L.*, Coconut

#### General Characterization

Origin: native to the coastal regions of tropical Asia and the Pacific, but its primary centre of origin is subject of speculation.

Use: The coconut palm has been called the tree of life, the tree of heaven and one of nature's greatest gifts to man because of its value as provider of so many useful products. For domestic oil extraction the fresh endocarp of mature fruits is grated and squeezed with hot water; for industrial production the endosperm is dried to copra and taken to the mill for oil extraction.

Properties: Fresh, mature coconut fruits weigh 1,1-2,5 kg and consist of 30-45% husk (exocarp and mesocarp), 14-16% shell (endocarp), 25-33% endosperm and 13-25% free water in the cavity. The proximate composition of fresh endosperm per 100g edible portion is: 35-52 g water, 34-45g oil, 3-4g protein, 9-11g carbohydrate, 2-3g fiber and 1-2g ash.

Propagation: Coconut palm is propagated by seed which is recalcitrant.



Coconut and Coconut palm

#### 3.8.1. Policy options

Coconut is planted widely in Cambodia close to the house. Little plantations exist. Most of the parts are being used by the farmers in their day-to-day life.

Coconut oil is not extracted, mainly because of the relatively high price of Cambodian coco-nuts compared to the price of coco-nut oil in the world markets. However for internal consumption coconut oil extraction might be interesting, as Cambodia imports all its cooking oils.

Besides oil also coconut fiber can be produced and processed in mats, blankets, mattresses and rubberized coir (availability of Cambodian rubber).

Other products include coconut-milk.

#### 3.8.2. Research and development options

Continue with the biological control of the Coconut Hispine Beetle (*Brontispa longissima*) using the natural enemy *Asecodes hispinarum*.

#### 3.8.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for coconut cultivation in Cambodia and train extension workers.

### 3.9. Priority NUS 9: *Durio zibethinus* Murray, Durian

#### General Characterization

Origin: The genus is native to South-East Asia and wild durian trees are found in Borneo and Sumatra.

Use: The ripe fruits, or rather the arils which form the edible part, are generally eaten fresh. The pulp of the ripe fruit is very appreciated by the Cambodians to whom it has the reputation to be fortifying, or even aphrodisiac. Too ripe, the fruit releases a smell of garlic that made Americans and European run away. The seeds are edible when they are boiled or roasted. There is no medical use in Cambodia even though in Malaysia from which the species is native, the leaves and the roots are used in traditional medicine.

Description: Large, buttressed tree, growing up to 40 m tall; bark dark red-brown, peeling off irregularly, and heartwood dark red.

Propagation: from seed, clonal propagation, grafting, etc.



Durian fruit

#### 3.9.1. Policy options

Durian is mainly grown in the southern province of Kampot and is famous for its special taste and smell. It is mainly grown for the national market.

During the last years, Phytophthora has emerged as the main problem in durian plantations.

#### 3.9.2. Research and development options

Research on Phytophthora should be the main focus; use of trunk-injections with phosphanate-solutions should be surveyed as this was found to be an effective control measure in Vietnam.

#### 3.9.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for durian cultivation in Cambodia and training of extension workers.

### 3.10. Priority NUS 10: *Citrus sp.*, *Citrus*

#### General Characterization

Origin: Citrus is not known as a wild plant anywhere but must have originated near the border between China and Vietnam.

Properties: The edible portion of a sweet orange fruit takes up 40-50 % and per 100g it contains: 80-90g water; 0,7-1,3g protein; 0,1-0,3g fat; 12,0-12,7g carbohydrates (sugars); 0,5g fiber; 0,5-0,7 g ash; 200 IU vitamin A; 45-61 mg ascorbic acid; 0,5-2,0citric acid. The energy value is about 200 kJ/100g.

Description: Evergreen tree, 3-15m tall, with rounded crown; twigs angular when young, usually with rather blunt auxiliary spines (on seedlings).

Propagation: Budding is the preferred propagation method.



Orange fruits

Photo source:  
[http://en.wikipedia.org/wiki/Image:OrangeBloss\\_wb.jpg](http://en.wikipedia.org/wiki/Image:OrangeBloss_wb.jpg)



#### 3.10.1. Policy options

Citrus is traditionally an important crop in the North-West of Cambodia. Here, Orange, Mandarin, Lemon and Grapefruits are mainly grown. During the last few years the area was significantly reduced due to Greening Disease (Huangblongbing-HLB).

Cold-storage facilities are needed, as well as processing plants for juice and pulp.

#### 3.10.2. Research and development options

Research should focus on a variety that is resistant to HLB. There should be more control of HLB vectors and HLB free plants (in-vitro culture) should be developed.

#### 3.10.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for citrus cultivation in Cambodia and training of extension workers.

### 3.11. Priority NUS 11: *Anacardium occidentale L.*, Cashew

#### General Characterization

Origin: in north-eastern Brazil

Uses: Cashew is cultivated for the nuts. Botanically the nut is the fruit; the cashew apple is the swollen, fleshy fruit stalk. The seed kernels are extracted by shelling the roasted nuts. In production areas cashew serves as food. Elsewhere it forms a delicacy.

Description: Evergreen tree, up to 12 m tall, with a wide dome-shaped crown. The foliage forms a thin peripheral canopy, studded with the protruding inflorescences.

Propagation: Fully mature nuts serve as planting material.



Cashew Tree

Cashew Apple

#### 3.11.1. Policy options

Cashew is mainly grown in upland areas. Most of the cashew is sold as Raw Cashew Nut (RCN) to Thailand and Vietnam. In Cambodia only one processing factory is operating.

#### 3.11.2. Research and Development options

Research should focus on varieties suited for the Cambodian agro-eco-systems, as well as on the organic cultivation of cashew for niche-markets, and on biological control of insect pests.

Research needs to be done on the use of other cashew products, eg. cashew apples for juice, wine or candy and Cashew Nut Shell Liquid (CNSL) extraction for export.

#### 3.11.3. Communication and awareness options

Extension guidelines (Technology Improvement Package-TIP) for cashew cultivation in Cambodia have been developed, training of extension workers is recommended. Promote small-scale processing of cashew-nuts.

### 3.12. Priority NUS 12: *Vigna radiata* (L.) Wilczek, Mungbean

#### General Characterization

Origin: Mungbean originated in India or the Indo-Burmese region. It spread in early times to most other Asian countries and more recently to other continents. In many South-East Asian countries Mungbean ranks among the three main grain legumes.

Use: The dried beans are prepared by cooking or milling. The seeds or the flour may enter a variety of dishes like soups, snacks and noodles. Popular as a fresh vegetable are sprouted mungbeans. Mungbean is sometimes specifically grown for green manure or cover crop.

Description: An erect or semierect, herbaceous annual, 25-130 cm tall. Flowers are large, diameter 1-2 cm, greenish to bright yellow, self-fertile, in clusters of 5-25. Pods are up to 15 cm long. Seeds are green or yellow, sometimes brown or blackish. Mungbean is a short-duration crop, usually flowering within 30-70 days and maturing within 60-120 days of sowing. Yields reach up to 2 tons/ha but are normally about 500 kg/ha or less.

Propagation: propagation is done by seed



Mungbeans

#### 3.12.1. Policy options

Mungbean is a crop that fits very well into the Cambodian cropping system. It can be grown either before the main rice-crop or directly after the rice-harvest. Due to its short duration it can take advantage of residual soil-moisture after the main rains have ceased. Being a legume-crop it also improves soil-fertility.

#### 3.12.2. Research and development options

Some research on Mungbean cropping systems is already being carried out and some new varieties have been developed. This will have to be continued to address problems related to diseases, soils and water-logging tolerance.

#### 3.12.3. Communication and awareness options

Develop extension guidelines (Technology Improvement Package-TIP) for mungbean cultivation in Cambodia and training of extension workers.

### 3.13. Priority NUS 13: *Nephelium lappaceum* L., Rambutan

#### General Characterization

Use: Rambutan is eaten as a fresh fruit. The flavour of a good rambutan should be sweet with a hint of acid and the flesh should come free from the seed easily. Seeds can be eaten roasted.

Plant description: The origin of rambutan is unknown. It is an evergreen, bushy tree up to 20 m high. The fruits are in clusters, red or occasionally yellow and covered with soft spines up to 2 cm on a thick seed-coat. The seeds are covered with a white aril. It grows best on deep and fertile soils. The main flowering period occurs during the dry season, with fruiting around 3 months later. Rambutan thrives in humid tropical lowlands. In some cultivars the percentage of male flowers is very low and hormone treatments are needed.



Rambutan  
fruits

#### 3.13.1. Policy options

Rambutan is grown throughout Cambodia; plantations are mostly situated in upland areas. Most of the crop is for home-consumption or local markets.

#### 3.13.2. Research and development options

There is little knowledge on Rambutan varieties in Cambodia and their potentials for production increase through improved crop-management or selection of parent-material.

#### 3.13.3. Communication and awareness options

Develop Extension guidelines (Technology Improvement Package-TIP) for rambutan cultivation in Cambodia, train extension workers.