

A Practical Nutrition Guide



**for Community
Development Workers**



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Introduction

An "agriculture-nutrition gap" exists due to agricultural development primarily focusing on poverty alleviation and not focusing on producing adequate nutrients to improve household nutrition. Community development workers have seen agricultural yields and household incomes increase but high malnutrition is still prevalent in communities where they work (Jayakumar 2014). Women play a key role in maintaining and improving household practices leading to good health. Additionally, they need adequate growth-nutrients like protein, zinc, sulfur, and magnesium from early childhood onwards and from pregnancy to their children's early childhood. A well-nourished mother can then pass on health benefits to her children particularly in the first 1000 days of life, where lack of nutrition will significantly impact a child's ability to fight infection and develop cognitive abilities into their adulthood.

In Asia, poor health is primarily caused by micronutrient deficiencies, but can be remedied by improving dietary quality and diversity, including balancing staple starches with a wide variety of vegetables and supplementing intake with animal-based proteins. The cost of buying vegetables has increased as experienced during the recent food crises and the effects of globalization have decreased knowledge and cultivation of traditional food plants by farmers shifting from traditional agriculture systems towards cash-cropping systems.

Neglected and underutilized plant species (NUS) present tremendous opportunities for fighting poverty, hunger and malnutrition, as well as to make farming systems more resilient to climate change. It is widely accepted that increasing consumption of locally available fruits, vegetables, roots and tubers can improve nutrition and complement current strategies to combat malnutrition (Kahane et al. 2012).

In this publication, ECHO Asia presents a food-based approach to improve household nutrition using neglected and underutilized plants that are also available as seeds or cuttings through its Regional Seed Bank. We have designed this publication to serve as a practical field resource for community development practitioners working at the household level.

The first section presents considerations for linking agriculture and nutrition to improve household nutrition and aims to provide practitioners a review of current research and thinking. The second section presents a simple food-based approach for improving household nutrition through increased consumption of neglected and underutilized food plants offered by ECHO Asia. Local food practices of communities in Southeast Asia are presented here, including plant collection and food preparation methods, based on surveys and interviews conducted by the author. The last section presents case studies linking agriculture and nutrition throughout Southeast Asia. The approaches range from an evaluation of a multi-country homestead food production program and identification of sustainable livelihoods through participatory wild foods assessment, to "training the trainers" activities, and seed exchanges.

May this publication be useful in your work fighting hunger and malnutrition.

-Ruth Tshin, September 2015

Key Considerations in Practical Nutrition in the Context of Community Development

Understanding the Agriculture–Nutrition Gap

Agriculture and nutrition at the community level can be understood simply as food production and food consumption, respectively. The general aim of farmers working toward improved agricultural productivity is increased income and hopefully reducing overall financial poverty. The aim of farmers and households working toward improved nutrition and diets is to eradicate disease and malnutrition. However, low agricultural productivity and chronic malnutrition mutually reinforce each other in poor communities. When farmers experience the results of shocks in to agricultural markets (for example, decreased market prices and/or lowered demand for cash crops), they struggle to save and maintain resources that during periods of stability would otherwise be used toward health and economic well-being. Meanwhile, a serious illness or livelihood setbacks reinforces poor health, preventing an individual's ability to climb out of long-term poverty.

Over the past few decades, agricultural development has primarily focused on poverty alleviation through maximizing production while minimizing costs. This approach was developed to meet the basic caloric needs of communities by increasing the production of staple crops, but has failed to focus on holistic nutritional well-being. The global trend in agricultural production from more diversified farming systems (which include indigenous or traditional farming systems and plant varieties) toward monoculture systems focused on cash crops seems to be contributing to micronutrient deficiencies in communities by narrowing the variety of food-crop plants that are eaten (Welch 2008). This "agriculture-nutrition gap" is partly the result of production-focused agricultural development not taking into account nutritional outcomes of communities that focus on food consumption and overall health; and nutrition and health communities not having considered farming as a primary and useful tool in their nutrition programs (Table 1). In response to this gap, international policy-makers and organizations are increasingly focusing on health and nutrition as significant factors in economic growth and poverty reduction, as well as agricultural production as a significant factor in improving health and nutrition.

Table 1: Pathways through which changes in agriculture affect health and nutrition (Adapted from Hoddinott 2011).

Changes in agricultural production can lead to:	Effect on health and nutrition:	Example:
Increase in household income.	Purchase of goods or investment of income that affect health status.	Positive effect: Improved clothing and ability to purchase improved health care. Higher income can be used to purchase more food, higher quality of food with less pathogens, or more diverse diet. Investment in improved shelter will improve health. Negative effect: Higher income can be used to purchase tobacco products that will damage health.
Introduction of new crops as a result of innovations in crop breeding (bio-fortified foods like orange sweet potato with increased Vitamin A).	Introduction of new foods into diet that increase nutrition.	Changes in food processing can affect foods consumed, such as foods fortified with micronutrients, or processing with excessive sodium levels that are harmful to health. Actions by private sector, governments or other actors can make existing foods produced within a country available to new markets. Reforms to tariffs and removal of barriers to agricultural trade permit entry of foods produced in the country.
Changes in types of crops grown or changes in production processes may make agricultural work more or less physically intensive.	Mechanization will reduce physical demands of agricultural labor, whereas crops that require greater manual weeding will increase it.	These changes affect exposure to pesticides, zoonoses, and work-related accidents.
Changes in allocation of resources within the household.	If this results in women earning greater income, then this may affect how households spend money, how food is allocated, and the types of assets that are accumulated.	

Farmers' Decision-Making and Their Effects on Household Nutrition

Farmers in the developing world are limited by economic decisions that are not always made in the interest of improving household health and nutrition. Smallholder farmers are directly affected by global consumer and producer behaviors that affect their income and resources. They are also impacted by physical settings (rainfall, elevation, soil, distances to market, access to safe water, etc.) that affect health and agricultural outcomes. The most challenging problem for farmers is their capacity to navigate shocks to their economic and physical settings, such as soaring food prices and adverse effects of climate change, while simultaneously adapting, responding to risk, and improving their resiliency.

Several considerations should be made in order to ensure that farming makes a positive contribution to improved household nutrition. Improvements in farm production through farm-level technical changes can lead to improved yields with increased income as a result. Food is the largest household expense for the poor and farming is their primary source of calories and nutrients, so improved production can potentially lead to increased food intake and improved overall nutritional status when total income, food expenditures, and diet composition are taken into consideration. Other approaches to ensure farming improves household health include ensuring production and household consumption of improved crop varieties rich in nutrients (eg. orange-fleshed sweet potatoes high in Vitamin A and leafy greens rich in iron and Vitamin A), as well as improving nutritional status and income by increasing diversity of foods produced and consumed by the household through home gardens and small livestock production.

Farming is especially effective in improving household nutritional outcomes when it increases incomes of the poorest households and benefits women within these households. This is confirmed by a number of studies, which demonstrate the benefits—for health, education, and nutrition of children—of women increasing their control over the use of incomes and assets within the household. When women benefit from the increased opportunities and incomes that agricultural productivity gains allow, the incomes they control will be used for the health, education, and nutrition of children more than when household incomes are controlled by men.

Agrobiodiversity

Agricultural biodiversity (or “agrobiodiversity”) is critical for food and nutrition security. Although 30,000 edible plant species have been identified, no more than 150 crops are produced at a global scale. Of these, 103 crops provide 90% of the calories in the human diet (Prescott-Allen 1990) with rice, wheat, maize, and potato providing 60% of the human energy supply (FAO 1998). Changes in land use, land degradation, deforestation, and habitat loss have also had severe negative impacts on agrobiodiversity, including wild relatives. **Climate change** is expected to speed up the loss of global agrobiodiversity as some areas become unsuitable for less-tolerant varieties. The market also plays a major role in affecting the diversity of crops consumed through changing food habits as the result of globalization. Emerging middle-class populations are shifting

from traditional to “modern” foods, usually Western foods, while supermarkets demand quality, quantity, uniformity, and regularity of supply that favors large-scale farming.

Plant and animal species with **under-exploited potential** can be important for contributing to improvements in household food security, health, and income generation. The Food and Agriculture Organization of the United Nations (FAO) estimates that 80% of populations in developing countries can use these “**neglected and underutilized species (NUS)**” to meet health and nutrition needs (FAO 1998). Terms such as underutilized, neglected, orphan, minor, promising, niche, local, and traditional are interchangeably used to describe these potentially useful species that are not commonly found in mainstream culture and economies, but have significant local importance and global potential to improve food and nutrition security. In this publication, we will refer to these plant and animal species as “neglected and underutilized species” or NUS.

Erosion of agricultural biodiversity has serious implications for agriculture – the loss of resilience in the face of climate change, social and economic shocks, and less ecosystem functionality. Enhancing diversity by growing alternative food and forage crops will not only diversify agroecosystems, but will improve their adaptability to extreme climatic conditions and reduce susceptibility to pests, biotic, and abiotic stresses. Incorporating NUS into farming systems is one aspect of **adaptive or “climate-smart” agriculture** that focuses on minimizing soil disturbance, maintaining permanent soil cover, water conservation practices, and crop diversification to include early maturing and drought-tolerant plant varieties. Many NUS plants have these characteristics that enhance increase the capacity of farming systems to respond to environmental shocks and the capacity of the farmer to diversify their livelihoods. In India, “minor millets” include foxtail millet, proso millet, and finger millet varieties that perform well in conditions where major staple crops would fail, in regions with erratic rainfall and scarce water supply or low-quality arable land. Important in tribal and hill agriculture, these varieties have a short life cycle and efficient root system, and offer modest yields in poor soils with low inputs (Padulosi et al. 2009).

Concerted efforts to link NUS, agrobiodiversity, and improved household nutrition are a relatively new practice. Using resources from Bioversity International, ECHO Asia has adapted a list of key issues related to considerations to take when approaching agrobiodiversity as a community development practitioner (Table 2). These tools can be adapted into training materials for engaging community leaders, extension workers, and farmers about agrobiodiversity.

Climate-change adaptation and mitigation approaches should be emphasized in agricultural landscapes to address key issues faced by farmers. “Climate-smart” agricultural practices, including the incorporation of NUS, should provide both climate-change adaptation and mitigation benefits at the plot, farm, and landscape levels in order to provide the foundation for farmers to achieve more productive, sustainable, and resilient agricultural livelihood activities that are linked to nutrition outcomes (Table 3).

Table 2: Key considerations for community development practitioners regarding linking underutilized plants, agrobiodiversity, and household nutrition (Adapted from Bioversity International materials).

Considerations:	Questions to ask:
Research is showing the value of agricultural biodiversity when integrated with health care, education, water and sanitation, and farming systems, but there is need for more evidence to support this thinking.	<ul style="list-style-type: none"> How can I integrate agricultural biodiversity to our development projects or programs? How can I (or our organization) collaborate with partners to design, monitor, and evaluate development projects or programs that integrate agricultural biodiversity with agriculture and nutrition goals? How can I generate evidence of these programs' health and nutrition benefits and cost effectiveness?
How does my work strengthen and provide actual evidence of agrobiodiversity's role in nutrition and health in my community?	<ul style="list-style-type: none"> How can I describe and define the role of agricultural biodiversity in diets, health, and nutrition (including the nutritional value, use, and consumption patterns of foods derived from agrobiodiverse landscapes) and their impact on human nutrition and health outcomes? Do I understand the socio-cultural and traditional roles of foods in my communities and households, including why certain foods are eaten, and the role of traditional food systems in decisions about consumption?
Research is showing that the role of markets and value chains can improve household nutrition and dietary diversity through:	<p>Increasing farmers' production of nutritious food in a more diverse system. Increasing farmers' income so that they can access more nutritious foods</p> <ul style="list-style-type: none"> How can smallholder farmers in my community diversify their diet and improve their nutritional status by: <ul style="list-style-type: none"> Producing more biodiverse foods themselves? Accessing more nutrient-rich and diverse foods in markets through a rise in their disposable incomes? How can I increase my understanding of how local and international consumer demand can increase the supply of nutritious food by smallholder farmers How does the increased income of smallholder farmers in my community affect their attitudes toward growing more diverse food crops? What are attitudes towards "traditional" and underutilized foods among rural and urban consumers in my target area? What kinds of formal and informal markets exist in my area? How do nutritious and traditional and underutilized foods create demand for rural and urban consumers? Can these varieties boost disposable income for farmers?

Table 3: Identification of key issues related to "climate-smart" farming (Adapted from Bioversity International).

Key issue:	Example content:
Adaptation for climate change	<ul style="list-style-type: none"> Matching crop varieties to changing climates Breeding for adaptation to climate variability and change Farmer resilience and adaptability
Agricultural economics	<ul style="list-style-type: none"> Value chains for neglected or under-utilized species Marketing for specialty foods
Agricultural policy	<ul style="list-style-type: none"> The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) The Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture The FAO "State Of" reports on plant, animal, and forest genetic resources
Agronomy	<ul style="list-style-type: none"> Farmers' seed systems The use of diversity to mitigate risk
Crop science and plant breeding	<ul style="list-style-type: none"> Gene bank management Participatory plant breeding Pre-breeding Wild relatives of crop species
Ecosystems conservation	<ul style="list-style-type: none"> Pollination In-situ and on-farm conservation of varieties or non-timber forest products
Ethnobotany	<ul style="list-style-type: none"> Selection and management of wild plants Cultural significance of crops and wild plants Pharmacologically active plants
Health and Nutrition	<ul style="list-style-type: none"> Food diversity and composition Nutrition and traditional foods Traditional medicine
Soil and water management	<ul style="list-style-type: none"> Resilience in ecosystems Microbial diversity

Neglected and Underutilized Species (NUS)

Despite increasing loss of agrobiodiversity in farming systems, NUS are largely ignored by agricultural researchers, plant breeders, and policy makers. NUS are the **wild or semi-domesticated varieties and non-timber forest species** (typically referred to as non-timber forest products or NTFPs) that have adapted to particular, often local, environments. Many of these species are being lost at an alarming rate, along with a wealth of traditional knowledge about their cultivation and use. NUS present tremendous opportunities for fighting poverty, hunger, and malnutrition, as well as for making farming systems more resilient to climate change. NUS have an important role to play in moving agricultural development beyond the Green Revolution model of mono-cropping to improve the yields of staple crops.

Neglected and Marginalized

NUS often suffer from a **negative image**, as they are often considered "old-fashioned" and associated with the rural poor in the eyes of newly urbanized populations, who prefer modern, export-quality or imported food products. The rural poor also may look down upon their traditional crops, in favor of a few commercially dominant crops, and this can lead to a loss of accumulated knowledge of cultivation and usage of these crops.

Scientific research and agricultural extension efforts have focused on major crops and staples with community economic value to the detriment of local crop diversity and practices. Decades of international policies influenced by political and economic factors and supporting major crops and staples have contributed to marginalization of NUS, even though they have important characteristics that promote sustainable livelihoods and climate change resilience. Most countries' capacity for NUS research and extension work is weak, because their governments receive funding and assistance for promoting major crops. In contrast, NUS are local crops that are may be conserved primarily through *in-situ* cultivation (i.e. in forest ecosystems) or informally on small patches of land or in home gardens by millions of smallholder farmers, instead of coordinated efforts like national seed banks (also known as gene banks).

Significance of NUS in Food Security and Food System Resiliency

With population growth expected to reach 9 billion people by 2050, **NUS have potential to contribute to food security at local and regional levels in a sustainable way**, while also contributing to diverse agricultural and food systems that protect the environment, provide healthy and nutritious foods, and provide livelihoods for farmers. At the national level, NUS can strengthen a country's food system and buffer economic and social shocks that will affect the population as the result of dependence on a narrowing spectrum of food crops. When major staples have failed, due to shocks or natural disasters farmers historically have returned to and relied on these "**famine foods**." In this context, NUS can provide a safety net during periods following disasters and emergencies when major food crop stocks are unstable or unavailable.

Although NUS may have lower yields than staple crops, they compensate for this by being more resistant to biotic challenges and providing dependable harvests in unfavorable climatic conditions or on difficult soils. Climatic adaptive capacity is a key trait of NUS: they grow in poor areas where agroecological conditions predominate, and where smallholder farmers do not have the means to adopt high-input agricultural practices geared towards major staple crops. Farmers maintain high levels of traditional varietal diversity, which provides insurance, since these are the varieties best-adapted to marginal ecosystems and heterogeneous environments, and the most resistant to local pests and diseases.

NUS and Nutrition

Out of 7 billion people, an estimated 500 million still suffer from protein-energy malnutrition while over 1.6 billion suffer from iron deficiency, 200 million from Vitamin A deficiency, and 400,000 children die each year from effects related directly to zinc deficiency (HarvestPlus 2011).

In the decades following the Green Revolution, the focus of agricultural development and research was to increase crop yields to ensure adequate calories for people who would otherwise have gone hungry. Less attention was placed on nutritional quality, leading to diets deficient in essential vitamins and micronutrients. NUS can provide essential micronutrients and complement staple foods - they are high in carotenoids and minerals, provide flavouring to local cuisine, strengthen local gastronomic traditions, and provide income opportunities for urban and rural poor.

It is widely accepted that increasing consumption of locally available indigenous or traditional fruits, vegetables, grains, roots, and tubers can improve nutrition and increase human productivity (Bala Ravi et al. 2006; Smith and Longvah 2009; Frison et al. 2011; Mayes et al. 2011; Kahane et al. 2012). **NUS and NUS-based food systems can help curb food insecurity of the poorest by complementing more current strategies to address malnutrition** (for example, increasing intake of fruits, vegetables and fortified food products, and increased consumption of animal protein) that are commonly out of reach for the poorest in developing countries (Ruel et al. 2005). NUS and NUS-based food systems can also address what is referred to as "hidden hunger" prevalent in South Asia and Sub-Saharan Africa, where populations have achieved sufficient caloric intake and so are no longer considered "hungry," but still exhibit micronutrient deficiencies.

NUS can also improve diets that are too rich in refined carbohydrates and fats, as the result of a rapid transition from traditional diets based on local foods to a Western-style diet high in fats, salt, sugar, and processed foods. This has led to increasing incidences of non-communicable diseases like diabetes, obesity, heart disease, and types of cancer. By increasing consumption of NUS, opportunities increase to enrich diets with healthier foods that appropriately reflect local food culture.

NUS and Livelihoods

Strategic interventions can be made to make NUS more **commercially competitive** by developing improved "modern" varieties. Poor competitiveness in poor rural areas has arisen from lack of capacity to negotiate with the private sector to access new technologies and markets that would increase potential demand for these local crops.

Developing markets for non-staple crops can benefit poor communities. Approaches include: promoting niche markets through denomination of origin (DO), eco-labelling, fair trade, organic, and Slow Food initiatives (Kahane et al 2012). Developing markets for NTFPs (a category of NUS) can alleviate poverty in forest margins or forest dwelling communities. Many NTFPs, including rattan, bamboo, resins, and medicinal plants, already have some commercial value to significantly contribute to rural cash incomes and are entry points for rural development strategies (Wollenberg and Belcher 2001).

Consumers must be educated about diversity and be willing to pay for products that support diversity. Higher-value niche markets can be developed through strategic placement of NUS in large commercial outlets, such as supermarkets catering to urban populations and the developing middle-classes. Training stakeholders in value-chain development is important, as well as increasing availability of credit to small producers and micro-processors. Training should cover a broad array of topics, including: processing, packaging, bookkeeping, economics of scale, accessing market information (i.e. through channels such as text messages on mobile phones), negotiating with different market actors, and learning how to respond to market fluctuations (Kahane et al. 2012)

NUS and Cultural Identity

Indigenous populations often experience extreme poverty, discrimination and marginalization, yet are the ones who "...retain knowledge of the land and food resources rooted in historical continuity..." Along with marginalization, these populations experience loss of cultural and traditional knowledge associated with their foods and lifestyles and the disappearance of traditional crops. "...traditional food systems... touch the full spectrum of life in ways that modern food systems do not." Increasingly sophisticated agricultural technologies have "...led to great disconnections between people and their food." (Kuhnlein 2009)

Traditional food systems and cultural identity of indigenous people are intertwined. Traditional knowledge of local ecosystems and food sources has evolved and accumulated over time and generations but has been lost at a rapid pace as eating habits shift toward "modern" foods. The international community is increasingly recognizing that conserving traditional food systems is a powerful approach toward saving local ecosystems and food sources (Padulosi et al. 2011).

Many indigenous groups are actively finding ways to combat the loss of their food heritage and their sense of "connection to the land." **Of critical importance are the ongoing attempts to document, before it is lost, the indigenous knowledge of local**



Figure 1: Celebrating diversity of forest foods in Northern Chiang Mai Province, Thailand (photo credit: Ruth Tshin).

food plants, including their growth requirements, storage and other post-harvest needs and methods of food preparation (Padulosi et al. 2011).

Conservation of traditional food systems is important for migrant groups that characterize modern society. Many migrants are often from traditional rural communities where off-farm labor is a significant component of livelihoods and causes individuals to leave home villages and regions in search of work in urban areas. In urban areas where land tenure is a challenge, having access to traditional foods and methods of preparation is important for maintaining a connection with migrants' cultural roots and fostering cohesion among fellow migrants.

Gender Considerations Along the Food Pathway

The global food price crisis exploded in 2007-2008, with increased international prices driving commodities like rice, wheat, and maize out of reach of severely food-deficit countries. Rural poor households were the most affected – although they are dependent on farming these household are often net food-buyers because they do not produce enough food to be self-sufficient and governments do not provide adequate social safety

nets. Poor net food-buyers are more greatly affected during price increases because they dedicate the largest portion of their household budget to food purchases.

Women are particularly vulnerable and the first to be impacted when prices of staples rise due to climate change and economic speculation. Women comprise 43% of the agricultural labor force, filling roles as farmers; unpaid workers on family farms; paid or unpaid agricultural laborers on other farms and agricultural enterprises; food processors or vendors; home gardeners; cooks; and caretakers for the elderly and children. More often than men, they experience extreme poverty, and as the head of household if no male is present, have less purchasing power due to fewer economic opportunities related to lower educational levels, wage disparities, and income insecurity.

Undernutrition and malnutrition of women affect women themselves, their households, and the next generation of women. Poor nutrition of a mother during pregnancy and the child during its first 2 years of life has long-term consequences for the child's physical and mental development. 42% of women worldwide suffer from anaemia as a result of iron deficiency, which leads to low birth weight, and affects subsequent infant mortality. In 2008, maternal undernutrition (where a mother has a body-mass index of less than 18.5kg per square meter) affected more than one-fifth of women in Southeast Asia and more than two-fifths of women in Bangladesh and India. Maternal undernutrition is associated with intrauterine growth restriction, which can lead to a child's retarded mental and physical development.

Healthy women are the key agents of change for improving overall household health and nutrition. Many women hold valuable knowledge about cultivation, processing, and preservation of nutritious and locally adapted food crop varieties. When rural women control household assets and decide what to produce, they tend to favor the production of food crops that ensure food security for the family. Men, on the other hand, will more frequently show a preference for cash crops sold on markets (FAO, IFAD, and ILO 2010). Where households are relatively food insecure and price volatility of markets is high, the availability of food from self production can be essential. Various initiatives have thus sought to promote homestead food production—particularly of fruits, vegetables, and livestock—by women who can combine such production on gardens with household chores and the care of children, with encouraging results in improving dietary diversity.

Agriculture is especially effective for improving nutritional outcomes if it increases incomes of the poorest households and benefits women within these households. When women benefit from the increased opportunities and incomes that agricultural productivity gains allow, the incomes they control will be used for the health, education, and nutrition of children - more so than if household incomes are controlled by men. This is confirmed by a number of studies which converge in demonstrating the benefits—for the health, educational, and nutritional outcomes of children—of women increasing their control over the use of incomes and assets within the household.

The Concept of the Food Pathway

Food travels along a pathway from the places it is produced to the people who eat it. At the start of the food pathway, food is built up from soil nutrients; at the end of the path, the body breaks the food down into nutrients again and then uses them for energy and body development. The pathway in between can be of varying lengths and complexities, and influenced by customs and practices (Table 4).

What alters the amounts of food travelling along food pathways?

- Enough food must be produced
- Enough food must be stored
- Enough food must get to the places where it is needed
- Families must have enough money to buy foods which they cannot produce
- Each person in the family must eat enough food

Factors that affect food availability:

- Positive: good weather, credit for farmers, good storage systems, post-harvesting processes, etc.
- Negative obstacles: production, storage, distribution and marketing, buying food, preparation, sharing and eating, use of food by the body.

Women and the Food Path

Women are the people who move food along most stages of the food pathway. If women receive more support and training, more food will move along the pathways and families will have more to eat.

Consider the important roles of women in supporting household well-being:

- Women make up 43% of the labor force in developing countries yet their importance and their role as farmers is under-represented. However, they grow almost all the traditional foods such as roots, legumes, and vegetables. As such, they have large amounts of technical knowledge about cultivation, processing, and preservation of nutritious and locally appropriate crop varieties.
- Women face more constraints than men: they own less land; have limited ability to hire labor or sell assets; and have less access to agricultural credit, extension services, other investment; and training.
- Women help to care for animals, especially small animals and poultry.
- Women and children gather wild foods such as green leaves and fruits. Women also process food, including threshing and pounding cereals, souring milk, and cleaning and drying fish and vegetables. Women and children collect firewood and water to prepare the food. Women prepare the meals and clean up afterwards.
- Many women earn money to buy some or all of the family food.
- Women feed young children, including breastfeeding them.
- Women feed and care for old or sick relatives.

Table 4: Customs and practices which affect food pathways (Adapted Nutrition for Developing Countries 1993).

Old customs which help enough food to reach people:	Old customs which may block food pathways:
<ul style="list-style-type: none"> Traditional methods of agriculture and fishing which preserve the soil, fish stocks, etc. Giving special foods such as chicken or sour fermented porridge to women who are pregnant or have recently delivered Giving a new mother a rest from work for some time Breastfeeding for 2 years or more; breastfeeding at night Eating fresh or whole foods instead of processed foods (for example, eating dark leafy greens instead of cabbage; fresh fruit instead of bottled drinks) Having 2 or more years in between babies 	<ul style="list-style-type: none"> Having large families Men controlling the family food budget Bulky weaning foods Men being given the biggest share of the family food pool Not sending girls to school
New practices which help food to move along food pathways:	New practices which may block food pathways:
<ul style="list-style-type: none"> New sustainable methods of agriculture which increase yields Modern methods of large-scale food processing, storage, and marketing The use of grain mills which reduce women's work More girls going to school. Women with more education are likely to feed and care for their families well and have fewer children More families using electricity, piped water and other modern technology which makes food preparation easier and cleaner More families listening to the radio and reading newspapers and magazines, from which they get useful new information about food production, budgeting, and preparation, and about feeding children and prevention of infections More families using effective methods of contraception to space children and reduce family size Women having more control over the money that they earn More children attending clinics for immunization, growth monitoring, and early treatment of infection 	<ul style="list-style-type: none"> Bottle feeding Women going out to work and leaving babies with young, inexperienced care takers Fewer extended families and many women, including adolescent girls, raising families on their own People preferring foreign foods, such as wheat for bread, that may not be easy to produce locally Practices which lead to babies being born too close together Eating poor value 'convenience foods' instead of fresh, whole foods

What you can do
<ul style="list-style-type: none"> Facilitate discussions within communities about local customs and practices that influence the way food moves along the whole food pathway. Help community members identify customs and practices that help every family member to have enough food, and those which may block food paths Help people to plan ways to change blocking customs and practices: <ul style="list-style-type: none"> Encourage customs and practices that help food to move along the pathway Encourage breastfeeding vs. bottle feeding Encourage families to share food by nutritional needs Encourage men to give women more control over the family budget Encourage girls to stay in school as long as possible

Table 5: Where on the food pathway do you (the development worker) work? (Adapted from Nutrition for Developing Countries).

Stage of food pathway:	Type of worker:
Production/Storage	Agricultural worker
On-farm processing	Home economist, Nutritionist
Trading	Home economist, Nutritionist
Buying and/or Harvesting	Home economist, Nutritionist
Preparing	Home economist, Nutritionist
Sharing and eating	Home economist, Nutritionist
Using	Health worker

Womens' heavy workloads create obstacles along the food pathway, because they are unable to find enough time and energy to do all that is needed to feed the family sufficiently. Particularly during planting and harvesting periods, women may be undernourished and lose weight, especially if they are pregnant or breastfeeding.

Women who have the heaviest workloads are:

- Poor rural women*
- Women who are heads of the family*, who receive no support from husbands or other relatives. A woman may be a temporary head if her husband is working away from home; if she is not married, or is divorced, or widowed, or her husband is sick. Families in which women are the permanent heads of household are often the poorest and most under-nourished in the community.
- Older women who look after many grandchildren*, if their partners or their children are dead or work away from home. This is particularly prevalent in regions where AIDS has been a long-term problem.
- Women who have many closely spaced children*. A woman who is often pregnant has less time and energy to provide good meals. She may be anaemic during and

after her pregnancy. Caring for a new baby and all the other children takes much time. Many women of childbearing age are pregnant or breastfeeding 80% of the time.

Women like these above will have less time and energy for:

- Cultivating and producing food
- Earning money for buying food
- Collecting enough fuel to cook frequent meals
- Encouraging young children to eat
- Preparing special food for sick family members and encouraging them to eat and drink
- Join women's organizations, literacy classes, savings groups, etc. where they can learn better ways to produce, process, store or prepare food
- Attend young child or antenatal classes
- Ensure children remain in school

Health and Nutrition Considerations

While development practitioners have worked to improve agricultural production yields and household incomes, they have observed that **malnutrition persists in communities despite increases in overall agricultural yields and agricultural income.** Considering the food price shocks experienced in 2007-2008, there is greater need to work to address nutrition impacts through agricultural approaches.

The underlying determinants to experiencing adequate nutrition are: access to adequate nutritious food; healthy environments and access to water, sanitation, and health services; and adequate care practices for children and mothers. In turn, these underlying causes are affected by an array of basic causes, such as the political environment, gender equity, and economic resources. There is a growing need for "nutrition-sensitive" developments in the agricultural cycle, because agriculture is a direct determinant of household food consumption, household livelihoods and community food systems and is therefore of fundamental importance to human nutrition.

Adequate nutrition can be obtained by consuming a wide diversity of food groups that provide six classes of nutrients found in food: carbohydrates, lipids or fats, proteins, vitamins, minerals, and trace elements (Figure 2). **Adequate energy** is required to maintain basal metabolism, physical activity, and human growth toward overall well-being. In particular, pregnant and lactating women and children within the first 1000 days of life have different nutritional requirements which need to be taken into consideration when working toward overall community well-being. Inadequate nutrition intake and use of nutrients by the body can lead to undernutrition, which results in growth failure and specific micronutrient deficiencies (Figure 3).

Acute malnutrition is the result of a drastic deterioration of nutritional status in a short time and leads to wasting (rapid weight loss) or nutritional oedema (kwashiorkor) that reduces overall disease resistance and can impair whole body functions. According to

UNICEF, nearly 20 million children suffer from severe wasting at a given time. Wasting and kwashiorkor are most common in children aged 12 to 36 months. **Chronic malnutrition** or stunting is a slow, cumulative process caused by insufficient intake of nutrients or repeated infections or a combination of both. Stunted children may have normal body proportions but look younger than their actual age (Figure 4). UNICEF estimates that over 800 million people worldwide suffer from chronic malnutrition.

Micronutrients can be grouped in the following manner:

- Vitamins – water-soluble (B group, C) and fat-soluble (A,D,E,K)
- Essential minerals – iron, potassium, magnesium, calcium
- Trace elements – zinc, iodine, fluoride

Deficiencies in Type I nutrients show up as physical signs or specific diseases, where **Type II nutrient deficiencies** result in reduced overall growth (Table 6). Individuals with Type II deficiencies are stunted in growth and have no visual differences from "normal" individuals. Extreme Type II deficiencies can be characterized as weight loss.

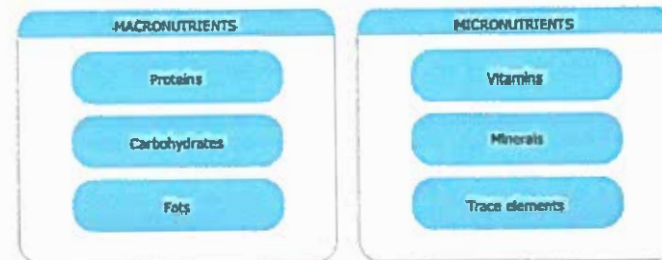


Figure 2: Macronutrients required for healthy human growth (UNICEF).

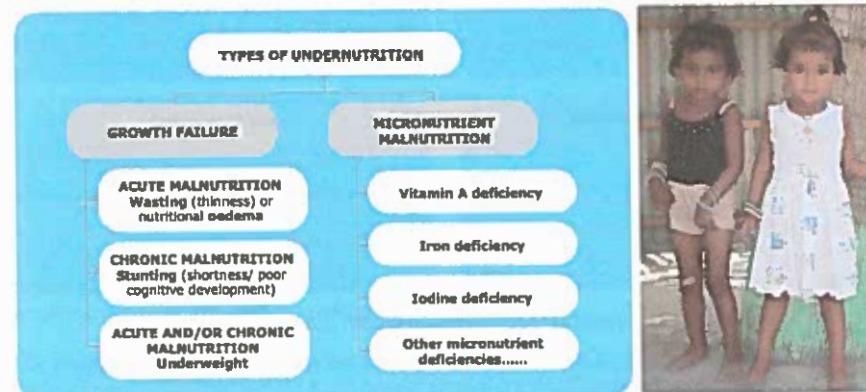


Figure 3: (Left) Results of undernutrition (source: UNICEF). Figure 4: (Right) An example of how stunting can look "normal". The girl on the left is 26 months and the girl on the right is 42 months old (WHO).

Table 6: Micronutrient deficiencies that lead to common diseases (UNICEF nutrition training (<http://www.unicef.org/nutrition/training/2.1/1.html>)).

Micronutrients, that if deficient, lead to Type 1 deficiency diseases:	Micronutrients, that if deficient, lead to Type 2 deficiency diseases:
Common diseases Vitamin A - xerophthalmia Iron - anaemia Vitamin C - scurvy Thiamin - beri-beri Selenium Calcium Ascorbic Acid Retinol (Vitamin A) Tocopherol (Vitamin E) Vitamin D Vitamin K Folate Nicotinic Acid Iodine Copper Manganese Riboflavin	Nitrogen Zinc Magnesium Sulfur Phosphorus Essential amino acids / Protein Sodium Potassium

MICRONUTRIENTS

Water Soluble Vitamins

Vitamin B6
Vitamin B2 - Riboflavin
Vitamin B1 - Thiamin
Vitamin B12 - Niacin
Vitamin C
Pantothenic Acid
Biotin
Folic Acid

Essential Minerals

Calcium
Sulphur
Iron
Potassium
Phosphorus
Sodium
Magnesium

Fat Soluble Vitamins

Vitamin A
Vitamin D
Vitamin K
Vitamin E

Trace Elements

Chromium
Cobalt
Zinc
Selenium
Iodine
Fluoride
Manganese
Silicon
Boron
Copper

Figure 5: Micronutrients required for healthy human growth (UNICEF).

Careful consideration is needed to include animal protein sources in diets. While greens and whole grains are rich sources of Type II growth nutrients, animal food sources such as red meat, seafood, small fish, rodents, insects, and nuts are important for providing a wide variety of nutrients and high-quality protein. Due to anti-nutrients found in plant food sources, such as phytates, which prevent absorption of Type II nutrients, animal protein sources are considered superior. Amaranth has high concentrations of zinc and magnesium as well as high levels of phytates. Beans and grains need to be soaked or germinated to eliminate anti-nutrients. Nutritionists consider animal source foods as key non-fortified, nutrient-dense foods that are easily digested by toddlers who have higher nutrient requirements, particularly after being weaned from breastfeeding at the 6-8 month age period.

Maternal and Child Health Considerations

According to the UN, over 90% of child deaths and 99% of maternal deaths worldwide occur in just 42 countries. A short list of direct and indirect conditions causes most of these deaths and these are similar across the developing world. These deaths are needless because they are prevented easily, effectively, and cost-efficiently or easily treated at home or in primary-care settings.

Preventing maternal deaths require adequate nutrition and care during a woman's pregnancy. But nutrition and care for children in early childhood (the first 1000 days of life) and throughout adolescence to ensure health is critical in addressing intermediate and underlying causes that eventually lead to maternal death. An agriculture-health based approach toward improving maternal and child health can include addressing the "hidden hunger" of micronutrient deficiencies focused on the first 1000 days of life through a balanced intake of culturally accepted growth foods that include animal protein and plants. Techniques such as backyard gardening and perennial agroforestry systems can help to provide fuel, food, and fodder to support small animal husbandry for household nutrition as well as generating modest income. To support these approaches, communities should have adequate access to clean water and understand basic sanitation practices such as hand-washing and latrine use.

Community Health Considerations

Anti-nutritive effects in plant foods present in a meal can prevent absorption of Type II nutrients, as well as iron, that are needed for adequate growth, particularly in early childhood development. For example, amaranth is high in zinc and magnesium but is also high in phytates. However, anti-nutritive effects in grains and beans can be reduced by soaking, germinating, and/or malting.

For many subsistence-farming communities, research from community-based efficacy trials suggest that household food-based strategies, including pre-processing methods of plant foods, in combination with participatory approaches, are important to increase awareness and acceptability of caregivers, while on-going nutrition education and

awareness efforts enhance adoption and empowerment of the community to sustain good health and nutrition practices (Gibson et al. 2006).

Food-Based Approaches

Food-based strategies can address the prevention and help overcome micronutrient malnutrition through food production, dietary improvement, and growing bio-fortified that are culturally and environmentally relevant foods. These approaches promote consumption of foods that are naturally rich in micronutrients and are considered sustainable for long-term interventions to impact health outcomes.

It is a well-known fact that lack of **diet diversity** is a crucial issue in developing countries where communities are heavily dependent on starchy staple foods. It is also widely accepted that consumption of a variety of foods across and within food groups almost guarantees adequate intake of essential nutrients and important non-nutrient factors (Bioversity 2011). Research studies have documented the linkages between dietary diversity, diet quality, and nutritional status of children, in addition to associations between dietary diversity, food security, and socio-economic status.

When planning food-based approaches to impact nutrition, careful consideration needs to be made about **seasonality, cost-effectiveness, and long-term sustainability** of production systems. Promoting production of locally available and locally-adapted agricultural biodiversity and promoting consumption of wild food diversity and a range of nutritionally-distinct food groups (Zwier 2011) can address these considerations, target multiple nutrient deficiencies, address climate change adaptation, and address year-round food security issues for local communities.

Dietary diversity can be used as an indicator of **food security**. There may be direct associations between dietary diversity and diversity of vegetables collected for consumption, and significantly increased association if farmers are involved in selling the vegetables or produced for sale (WHO FAO 2013). Clearly, increasing farmers' (particularly women farmers') involvement in marketing agricultural products could lead to an increase in dietary diversity, because **women are the main determinants of household diet and nutrition** (WHO FAO 2013). An increase in household cash income could lead to an increase in dietary diversity as women are primarily responsible for obtaining and preparing food for all household members. However, it is important to remember that the relationship between food production and nutrition of household members is not necessarily straightforward. There is a complex web of selling and purchasing food that is affected by the **gender and social biases** of who controls household income and holds power in the decision-making process.

Homestead food production (also known as home gardens or backyard agriculture) can have direct and positive impacts on dietary diversity and dietary quality of household members. However, it is important to also **examine social and gender biases and socioeconomic status as they relate to decision-making** in order to understand whether or not nutritionally-vulnerable household members are actually experiencing

improvements in overall nutrition. For example, are pregnant women actually receiving and consuming nutritionally important foods?

With an increase in overall dietary diversity, researchers found that there was decreased vegetable consumption with less nutritious foods such as processed and sugary foods, being added to the diet. So it is important to understand whether or not an increase in dietary diversity actually results in improving nutritional diversity and/or quality of the diet. One approach is to consider increasing diversity of one element of the diet (for example, vegetables) in order to maintain **nutritional quality**.

On-farm agrobiodiversity, if linked with improving nutrition, and health outcomes, and benefits, can contribute to more nutritious household food consumption. There is a global need to assess its contribution to local diets and the health and nutrition status of a community. An important issue to consider is how on-farm agrobiodiversity can be scaled up to improve farmers' incomes while maintaining biodiverse ecosystems and human health. **The local food chain can be examined for whether farmers can relate environmental issues with nutrients produced in their farming systems.** For example, a comparison of cropping systems in Ethiopia resulted in farmers expanding planting diversity to include beans, kale, and enset (an economically important food crop) while reducing staple crops of maize, barley, and sweet potato. Shifting from a cereals-based production system to a perennial, nutrient-rich crops system addressed soil erosion issues in the area and addressed farmers' health benefits (Amede et al. 2004). Although it is generally accepted that increasing on-farm agrobiodiversity increases nutritional capacity of the farmer, it is also important to understand whether an increase in crop diversity will contribute to a farmers' resilience to climate change AND increase his family's **nutritional diversity and quality**.

Continuing to Understand Other Linkages

Cultural acceptability, accessibility, and environmental sustainability need to be considered when linking agriculture to improving nutrition (including human health, livelihood, and wellbeing). Malnutrition needs to be viewed from the perspective of over-nutrition as well. How do agriculture and nutrition linkages affect the **triple burden of nutrition** (food insecurity, undernutrition, overweight + obesity) at individual, household and community levels?

Other important considerations can be made to continue to understand linkages:

- Understanding where food being consumed comes from
- Own production
- Collection from the wild
- Buying from markets
- Receiving as gifts
- Exchange of foods
- Food aid
- Promoting perennial food crops and production systems, such as agroforests

- Promoting foods with similar quality and nutrient content to substitute each other in order to fill nutritional gaps during certain seasons and compensate for food shortages
- Providing foods according to nutritional needs of the population (pregnant women, the first 1000 days of a child's life, etc.)
- Easing women's agricultural workload and increasing food availability through developing cropping schedules to diversify farm crops and more even distribution of planting and harvesting across the year
- Preservation and storage methods to extend shelf-life of collected foods



Figure 6: Lunch preparations at a Northern Thai home (Photo credit: Ruth Tshin).

A Food-Based Approach Using Underutilized Food Plants to Impact Household Nutrition

As a practitioner, it takes time to understand the food practices in your community. But it is important to understand food systems and related behaviors in order to promote and support good nutrition and health practices. Waves of migration of people groups from China, Burma, and Laos over the centuries have created a multi-cultural fabric in Northern Thailand and throughout the highlands of Southeast Asia. Their diets have been dependent upon starch staples such as rice, yams, and other roots, and wild collection or own production of vegetables, fruits, herbs, insects and small animals. These communities rely on subsistence food bases such as rivers, streams, swidden fields, and forests, gathering food daily near homes or along the way to working in rice fields. According to food anthropologist Penny van Esterik, "even considering the ecological diversity of the region, the same food shed may not produce the same food cultures." Common food preparation practices can be observed, though, among the diverse upland ethnic communities, resulting in a "mountain cuisine" that reflects the incredible biodiversity of food plants in the region and the art of "making do" with limited resources. But as communities respond to increasing influences of globalization, they are shifting away from creating dishes based on foods found near the village and moving toward modern preparation and consumption habits.

Food Plant Collection Practices in Southeast Asia

Location and Accessibility

Upland villages with access to all-season roads, mobile markets, multiple "food bases," and wild forest foods could be considered better off in terms of food security than remote villages with access to fewer food bases (Pirotte and Gordon 2011). Voluntary or involuntary relocation is a reality that many upland communities face, whether as a result of government policy, conflict, natural disaster, or economic migration. A common impact of relocation to deforested, lowland areas is increased land scarcity and decreased food security and sovereignty as a consequence of their inability to access traditional food bases. Resilient farmers may walk long distances to cultivate their original swidden fields and access traditional food bases (Pirotte and Gordon 2011), but the sad reality is that many communities lose traditional plant and food knowledge as they grow increasingly reliant on purchased foods and globalized consumption practices.

Collecting Plants for Consumption

Upland communities may rely on vegetables and herbs found growing in nearby forests or along walks home from tending the paddy fields. In contrast to modern society's practice of shopping for food at the grocery store, upland communities are familiar with edible varieties that may seem invisible to the untrained eye. Foraging is a subtle art of being

attuned to the changing availability of plants and plant parts growing in the forest and spotting tender shoots, roots, tubers, berries, etc. amidst all the lush verdant growth.

Whether cultivated around the home or taken from a forest, vegetables and fruits may come from bushes and trees that appear inedible. Tender shoots and leaves are picked daily from bushes and vines, edibles grow alongside ornamentals, and home gardens merge with the natural environment (Figure 7 & 8). Depending on access to food bases, individual family members may consume over 200 grams of wild plants a day (Delang 2005). Two or three types of food plants may be harvested in the early morning to be eaten during the day.

Food Consumption and Preparation Practices

Typical Food Consumption Practices

A typical meal is centred on rice as the starch staple (Figure 9) except during rice shortages, when cereals (for example, corn or Job's tears) and roots and tubers (such as wild yam) are eaten in substitution. A standard meal can include a vegetable soup, a pounded chili paste, fresh or boiled vegetables, and protein from small animals or insects caught during the day.

Vegetables, mushrooms, bamboo shoots, herbs, small animals, and insects are collected depending on the season. Communities with access to local markets may buy fresh (meat, fish, vegetables, fruits) and dry (snacks, candy, fat, and oil) food items, including condiments and monosodium glutamate (MSG). More than 50% of weekly household expenses may be spent on food purchases (Chotiboriboon et al. 2009).

Food is shared communally, with family members gathering together for meals seated on the floor with plates of food in the center (Figure 10). In glutinous rice-eating commu-



Figure 7: (Left) Harvesting wild rice paddy vegetables in Northwestern Chiang Mai province, Thailand. **Figure 8:** (Right) Cleaning rice paddy vegetable, for boiling and eating with spicy chili paste (Photo credit: Ruth Tshin).

nities, the rice is massaged into a ball and dunked into the soup or chili paste. Boiled or fresh vegetables are also used to dip into spicy pastes. Food is commonly eaten with ones' hands, but eating utensils are also regularly used. Breakfast may consist of leftovers from the previous night's meal or what was caught the previous day. Lunch may be leftovers from breakfast or whatever is caught and collected on the way to work in the rice or swidden field. Snacks can include boiled or grilled corn, sweet potato or taro, or items purchased from the local market. During planting or harvesting seasons, food is prepared and consumed at the field.

Practical Suggestions Toward Understanding Your Community's Food Practices

To bein understanding community food practices, consider some of the characteristics of wild or underutilized food plants that are valued by upland communities:

- Easily found in areas close to the village and commonly used areas
- Abundant
- Can be kept for a long period of time or stored well
- Can be collected over long periods during the year
- Height of shrubs or trees allows for fruits to be easily accessed and harvested
- Can be found in local markets

(Source: Savajol et al. 2012)

Qualitative data collection can contribute to a baseline understanding of food practices. The following three tables (Table 7-9) provide examples of community-based research that details seasonal collection patterns and processing methods of key food plant species consumed by a community in upland Cambodia (Savajol et al. 2012). Feel free to adapt these for your own context to help identify community food practices.



Figure 9: Meals are usually center around rice as the starch staple. **Figure 10:** Enjoying a simple family meal in a Palaung household (Photo credit: Ruth Tshin).

Table 7: Collection calendar of key species in upland Cambodia (Source: Nomads).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vowas												
Kdeav												
VorYeav												
Angheang												
Psettcheu												
Topeang												
Boom bree												
Vor Kooy												
Samrong												
Pong ro												
Phneav												
Krolanh												

Table 8: Key species management table for two villages in upland Cambodia. (Adapted from Nomads).

Local Name:	Habit:	Collection Place:	Practice:	Impact:	Domestication:	Market:
Vowas	Fem	In small ponds, near field, and along streams.	Picking the young leaves by hand.	No	Need to grow on wetland.	Yes, already sold, people like to eat.
Kdeav	Vegetable	Swidden fields, old fields, after cut new farm.	Picking the young leaves by hand.	No	Invasive plant; no need to grow.	Yes, already sold, people like to eat.
Anghaeng	Vegetable	Forest close to stream with shade, small ponds.	Cut the young stem with the leaf by hand.	No if not over harvested.	Can grow easily in humid place with muddy soil.	Yes, already sold, people like to eat.
Psettcheu	Mushroom	On dead logs in forest or farm.	Picking the whole mushroom by hand.	No	No but could be if growing close to water.	Yes, popular; has good taste.
Topeang	Bamboo	Bamboo grove	Break the young shoots by hand.	No if not over harvested.	Grow in a humid place from young plants with roots.	Yes, popular
Boom bree	Root	Close forest, old swidden fields.	Dig a hole with a hoe to take the root out.	Yes	It is already integrated into swidden farms. Can be propagated by roots.	No
Kooy	Fruit	Evergreen forest, close to water sources.	Cut the plant to collect fruit.	Yes	Needed. By cuttings it is very easy to grow under any trees.	Yes, fruits are sold at good price.

Table 9: Table of the main processes for utilizing key species (Adapted from Nomads).

Local Name:	Handling:	Cooking Practices:	Storage:	Storage Process:	Eating Frequency:
Vowas	Cleaning and cutting in pieces to keep only the young and good quality leaves.	Fried, soups, and used as vegetable for other food styles like Khmer people do.	After more than one day of storage the leaves fade and did not have good taste.	No	Almost every day.
Kdaev	Cleaning and cutting in pieces to keep only the young and good quality leaves.	Steam, pound, fry, soups, spicy soups composed of many kinds of vegetables, Prong Msao.	Can be kept only 2-3 days; after that, it is not good.	No	Almost every day.
Anghaeng	Cleaning (to avoid itchinness), and cutting in pieces.	Fry, Prong, soup, boil for eating with anything.	Kept 2 to 5 days after processing.	Packaged with banana leaves and soaked in water.	1-2 times per week (rainy season).
Psettcheu	Cleaning well to remove small worms and cutting in pieces	Slur Bok, soup, fried, etc.	1 year after it is processed.	Needs to be boiled/steamed.	2-3 times per week.
Topeang	Cleaning and cutting into pieces.	Pickled, soup, cook as a sweet, a spicy soup composed of many kinds of vegetables.	Can be kept for 1 to 12 months after processing.	Pickle or dry it. Keep in a safe place.	1-2 days per month.
Boom bree	Cleaning, remove skin, cutting in pieces and steam/boil.	Boil or steam, eat with sugar, and boil with rice.	7 to 8 months.	Need to dry after cooking. Store in a safe place.	1-2 times per week.

Enhancing Nutrient Uptake and Reducing Anti-Nutritive Effects

Underutilized food plants have many beneficial nutrients (Table 10) which can be enhanced when eaten in combination with other foods (Table 11) or processed before consumption (Table 12). However food-based approaches must also take into consideration the toxic and anti-nutrition elements of some of these varieties (Table 13). In many cases, reliable and adequate nutritional data is not available due to lack of funding for research on underutilized food plants.

However, a few general rules of thumb can be considered when incorporating wild and underutilized plants into diets:

- Eat a wide diversity of leafy green vegetables
- Eat each type of plant in moderation
- Reduce the effects of oxalates, polyphenols, and tannins by cooking before consumption
- Soaking, de-hulling, germinating, and fermenting help to de-activate or remove anti-nutritive elements
- Roasting yams, taro, etc. reduces anti-nutritive effects

While degradation is a possible side effect of processing foods before consumption, there are foods that also enhance nutrient intake when eaten together with particular food types (Table 11).

Thermal and mechanical processing methods can also be used to inactivate anti-nutritional factors, therefore enhancing availability of beneficial nutrients (Table 12).

Household food processing and preparation methods can enhance overall nutrient by inactivating anti-nutritive factors such as phytates and oxalates. However the use of heat and mechanical methods can also lead to degradation of the beneficial nutrients as well (Table 13). Overall, moderation and diversity is a good rule of thumb!

Table 10: Nutrients from plant food sources (Edible Leaves of the Tropics, Martin et al. 1998).

Nutrients:	Plant Food Source:	Summary:
Vitamin A	<ul style="list-style-type: none"> • Orange, yellow, and green fruits and vegetables • Oils 	<ul style="list-style-type: none"> • Vitamin A is found in leaves in the form of provitamin A carotenoids which are converted by body to vitamin A • Carotenoids are heat-resistant • Leafy greens should be shredded to make beta-carotene more available • Rapid post-harvest deterioration of vitamins, so best to eat freshly picked leaves, store them cool and moist or wrapped in plastic to be cooked as soon as possible • Beta-carotenes found in mangoes, sweet potatoes, and pumpkins more easily absorbed by the body
Vitamin C	<ul style="list-style-type: none"> • Citrus fruits • Papaya, guava • Peppers • Dark green leaves 	<ul style="list-style-type: none"> • Destroyed by heat • Anti-oxidant
Vitamin B (including riboflavin and thiamine)	<ul style="list-style-type: none"> • Dark leafy greens 	<ul style="list-style-type: none"> • Water soluble, so can be lost if cooking water is thrown out
Iron	<ul style="list-style-type: none"> • Dark green leaves • Legumes • Whole grains 	<ul style="list-style-type: none"> • Nutrient uptake enhanced if consumed with vitamin C (for example, citrus) • 6-12% of iron found in amaranth is bioavailable
Zinc	<ul style="list-style-type: none"> • Spinach • Nuts and seeds 	<ul style="list-style-type: none"> • Absorption enhanced by eating with protein and organic acids
Calcium	<ul style="list-style-type: none"> • Green leafy greens 	<ul style="list-style-type: none"> • When present as an oxalate, not soluble and not taken up in digestive tract
Phosphorus	<ul style="list-style-type: none"> • Green leafy greens 	
Protein	<ul style="list-style-type: none"> • Green leafy greens 	

Table 11: Nutrient enablers for different food sources (World Renew, Gibson 2006).

Enablers:	Food Sources:	Nutritional Consequences:
Ascorbic acid	<ul style="list-style-type: none"> • Citrus fruit and juices. • Other fruits: guava, mango, papaya, kwi, strawberries. • Vegetables: tomato, asparagus, Brussel sprouts, spinach, etc. 	<ul style="list-style-type: none"> • Enhances absorption of iron • Counteracts harmful effects of phytates • May enhance folate bioavailability
Organic acids (citric, lactic, acetic, butyric, propionic, and formic acids)	<ul style="list-style-type: none"> • Fermented milk products (ie. yogurt), vegetables, sauerkraut, soya sauces, fermented cereals 	<ul style="list-style-type: none"> • Enhance absorption of zinc and possibly iron
Protein	<ul style="list-style-type: none"> • Animal and plant sources 	<ul style="list-style-type: none"> • Enhances absorption of zinc, iron and copper • Increases urinary excretion of calcium
Fats	<ul style="list-style-type: none"> • Oil seeds, nuts 	<ul style="list-style-type: none"> • Enhance absorption of fat-soluble vitamins A, D, E, K, and carotenoids

Table 12: Household food processing and preparation methods to enhance nutrient uptake (Gibson 2006).

Method:	Consequences:	Notes:
Thermal processing <ul style="list-style-type: none"> With water: boiling tubers, blanching leaves, steaming With heat only: grilling, roasting 	<ul style="list-style-type: none"> Inactivates anti-nutritional factors and improves availability of nutrients Degrades phytates (depends on plant variety, pH, and temperature) Releases nutrients from poorly-digested plant complexes for better absorption Boiling reduces oxalate content Enhances digestibility of proteins and starch Enhances bioavailability of thiamine, iodine, vitamin B6, niacin, folate, certain carotenoids 	<ul style="list-style-type: none"> Keep boiling times short to prevent degradation of nutrients Steaming may be better than boiling
Milling or household pounding	<ul style="list-style-type: none"> Reduces phytate content by removing outer layer or germ of rice, maize, sorghum, and wheat Increases availability of zinc, iron, calcium Pounding and pureeing vegetables improves availability of carotenoids 	<ul style="list-style-type: none"> Pounded cereals lose minerals and vitamins, creating need for fortified flours
Soaking/germination/malting	<ul style="list-style-type: none"> Activates activity of enzymes (phytases) that break down phytates and increase zinc, iron, calcium, and magnesium absorption Reduces polyphenol content of some legumes (fava beans) and enhances iron uptake Increases enzyme content of cereals (sorghum and millet) that enhances energy and nutrient densities of porridges and digestibility of starches 	
Fermentation	<ul style="list-style-type: none"> Breaks down phytates Increases content of organic acids Destroys protein inhibitors that interfere with nitrogen digestibility 	<ul style="list-style-type: none"> Enhances availability of zinc, iron, calcium May improve protein quality of maize, legumes, groundnuts, and pumpkin and millet seeds

Table 13: Anti-nutritive elements and how to reduce their effects (Weston A Price, Gibson 2006; Edible leaves of tropics)

Anti-Nutritive Component:	Food Sources:	Nutritional Consequences:	How to Reduce Anti-Nutritive Effects:
Alkaloids	Katuk/sweet leaf (leaves)	Excessive consumption can lead to dizziness and constipation among other effects	Eat raw leaves sparingly; eat cooked
Phytates	Unrefined cereals (found in bran or outer hull), legumes, nuts, oil seeds, leafy greens	Potent inhibitor of zinc, iron, calcium; magnesium poorly absorbed	Cereals and legumes: Sprouting or germinating whole grains, soaking, fermentation Leafy greens: blanching (not consuming cooking water)
Polyphenols (tannins and lignin)	Red sorghum, legumes (red kidney beans, black beans, black gram); spinach; betel leaves; oregano, cassava Tea, coffee, cocoa, red wine	Interfere with iron absorption Reduce thiamine absorption Reduce digestibility of starch, protein, lipids	Heat-resistant Cereals and legumes: De-hulling increases protein content and reduces polyphenols Leafy greens: blanching (not consuming cooking water)
Oxalic acid/oxalate	Amaranth, spinach, rhubarb, yam (leaves and tuber), taro, sweet potato, sorrel, sesame seeds, black tea	Reduce absorption of iron and possibly calcium Can lead to kidney stones and renal failure in susceptible individuals if consumed in excess	Tubers: roasting helps to decrease oxalates Leaves and stems: blanching and not consuming cooking water
Dietary fiber	Unrefined cereals, legumes, nuts, oil seeds, fruits, and vegetables	Reduces absorption of fats, fat-soluble vitamins, and carotenoids	
Cyanogens	Cassava, chaya	Leaves contain cyanogens that produce harmful hydrogen cyanide gas	Leaves: Boil for at least 15 minutes to release the gas and discard cooking water

Neglected and Underutilized Species: Plant Profiles

Amaranthaceae Family

Amaranthus tricolor

Vegetable Amaranth

ผักชอมผัก

Available from the ECHO Asia Seed Catalog.

- Vegetable amaranth originates from tropical Asia and is one of the major leafy vegetables in South and Southeast Asia and possesses an upright branched structure, whereby the young leaves and stems are eaten like cooked spinach. It prefers temperatures between 25 and 30°C (77-86°F) and although it grows best in a loam or silty-loam soil with good water-holding capacity, it can grow on a wide range of soil types and soil moisture levels. (ECHO Asia Seed Fact Sheet).
- Leaves taste like and have similar texture to spinach.
- The leaves are added as a vegetable to soups and stir-fried dishes or eaten raw as a salad.



Photo Credit: Kimberly B. Duncan

Araceae Family

Colocasia esculenta

Taro

เผือก/Diuun

Not available from ECHO Asia.

- Taro is a species that is indigenous to SE Asia and grows well in home gardens, mixed orchards, and moist agroforestry settings. There are varieties that prefer both flooded (or moist) and non-flooded conditions. The plant is mainly grown for its fleshy underground storage organ (corm) and propagation is typically asexual, using harvested and planted cormlets off the main mother corm. (Burnette, et al. In Press; TN 81).
- The corm is a mild-tasting starch staple that takes on the flavor of seasonings. The stem is generally mild-tasting as well.
- The young stem is added as a vegetable to soups or eaten raw as a dipping vegetable. Old stems are not palatable. The corm is a starch staple substitute eaten boiled, roasted or boiled in soups.



Photo Credit: Kimberly B. Duncan

Araliaceae Family

Trevesia palmata

Snowflake Tree

တာမာတု

Available as UHDP cuttings.

- Snowflake tree is a shrub-like tree which is indigenous to SE Asia and is found primarily in unexposed, moist forest sites, such as northern slopes and creek bottoms. However, it adapts well to home gardens and agroforest situations that constitute a biodiverse, multi-storied orchard that approximates the natural forest ecosystem. Although the small tree produces edible young leaves which are produced year round, the snowflake tree is best known for edible flowers that emerge during the cold season (Burnette et al. In Press; UHDP 2006).
- Shoots and flowers are bitter tasting.
- The shoots and young flowers are blanched and eaten as a dipping vegetable with chili pastes, or added as a vegetable to soups and curries.



Arecaceae (Palmae) Family

Calamus siamensis

Rattan, White Thorn

ရဝှေအုတ်မုတ်

Available as UHDP cuttings.

- Rattan is a bushy palm with thorns that has an erect, yet slightly vining habit that prefers unexposed, moist sites, such as northern slopes and creek bottoms, yet can tolerate full sun to partial shade. It is indigenous to SE Asia yet increasingly rare in the wild. Besides its food use, it is a desirable species for making cane furniture and can easily be used in agroforests, backyard gardens, improved long-fallows, and mixed orchard plantings (Burnette et al. In Press; UHDP 2006).
- Hearts of shoot are bitter
- Rattan hearts of shoots can be blanched or grilled and eaten as a dipping vegetable, added to soups and stews as a vegetable, or grilled and pounded into chili pastes.



Caryota mitis

Fishtail Palm

ต้นเตยร้าง

Available as UHDP cuttings.

- Fishtail palm is an indigenous forest species native to SE Asia which grows well in an agroforestry, home garden, or mixed orchard setting with various amounts of shade. It tolerates many different growing conditions, but prefers unexposed, moist sites, such as northern slopes and creek bottoms. It has traditionally been used for household consumption of its edible core (heart of palm) (Burnette et al. In Press, UHDP 2006; HEAR.org 2012).
- Hearts of shoot are tender and sweet-tasting.
- Fishtail palm heart of shoots can be blanched or grilled and eaten as a dipping vegetable or added as a vegetable to soups and stews.



***Asclepiadaceae* Family**

Gymnema inodorum

Chiang Daa

ผักขี้แมลง

Available as ECHO cuttings.

- Chiang daa (the common Thai name) is a perennial vine that can be found in disturbed areas throughout Southeast Asia. According to Chiangmai University researchers, chiang daa has high antioxidant activity and high levels of Vitamin E.
- The edible shoots and leaves have a nutty, spinach-like taste. It may be considered an acquired taste.
- Chiang daa is generally eaten as a dipping vegetable in Northern Thailand. Choose young shoots with immature leaves.



Athyriaceae Family

Diplazium esculentum

Vegetable Fern

ผักกูด

Available as ECHO cuttings

- Vegetable fern is indigenous to East and SE Asia and is probably the most important edible fern in the world. It is mainly found along river banks, open places in wet ground, or in the understory of moist forests at elevations below 900 meters. It is easily grown in home gardens, moist agroforestry settings, and may be planted densely in understory beds with heavy shade (Burnette et al. In Press; HEAR.org 2012).
- Shoots and tender stems have a slightly nutty flavor and a tender-crisp texture when blanched.
- Ferns can be blanched and eaten as a dipping vegetable with chili pastes or in salads, or added as a vegetable in stir-fried dishes. The tender stems snap off in a similar fashion to asparagus.



Basellaceae Family

Basella alba

Malabar Spinach

ผักบุ้ง

Available from the ECHO Asia Seed Catalog.

- Malabar spinach is a perennial twining (or vining) herb grown for its tender stems and leaves, which can be cooked like spinach. It is grown widely in the tropics as a perennial and in warmer temperate regions as an annual. It is easy to grow and does well in a variety of soils, but prefers humus-rich, well-drained soils with a pH range of 5.5–7.0. (ECHO Asia Seed Fact Sheet).
- The young leaves are mucilaginous and mild-tasting.
- Young and mature leaves can be eaten raw as a salad and as a vegetable in soups and stir-fried dishes. Use lime juice to reduce the mucilage.



Bignoniaceae Family

Oroxylum indicum

Indian Trumpet

เพกา(Central)/สิ้นฟ้า(Northern)

Available as UHDP seeds.

- Indian trumpet is a small tree that prefers well-drained, sunny locations, making it ideal for establishing mixed plantings of minimal-shading, food-producing plants in agroforestry or home gardening settings. It can be a pioneer species in a newly planted agroforest setting or even used along with pineapple, lemon grass, and tea as soil-conserving counter hedges (Burnette et al. In Press; UHDP 2006).
- The young dark-green pods can be harvested and stored in a cool, dry place for up to 4 days. The bitter flavor can be reduced by soaking in water overnight or less. The pods have a tender-crisp texture when cooked.
- For stir-fried dishes, slice the pods cross-wise into 1/4 inch thick pieces and soak in water. If eating as a dipping vegetable, whole pods can be roasted over glowing coals until the skin is charred. Remove the skin, slice into pieces and eat with chili pastes. The sliced pods can also be pickled in brine and stored.



Convolvulaceae Family

Ipomoea batatas

Sweet Potato

มันเทศ

Available as ECHO cuttings.

- Originally from South or Central America, sweet potato is now the 6th or 7th most produced food crop in the world. It is high in nutrients, has a relatively high productivity, and has the ability to thrive on a variety of soils, but moist, well-drained organic soils produce the best results. It is a tropical and subtropical plant which can adapt to more temperate climates if the average temperature does not drop below 20°C (68°F) and minimum temperatures stay above 15°C (59°F). It can be grown up to 2500m and requires full-sunlight for best yields (TN Sweet Potato 1988).
- Shoots and leaves taste similar to morning glory leaves. The versatile orange tuber is sweet tasting.
- The shoots and leaves can be added as a vegetable in stir-fried dishes or soups. The orange tuber can be roasted, boiled, fried or mashed.



Cucumis sativus

Cucumber

แตงกวา

Available from the ECHO Asia Seed Catalog.

- The cucumber is an annual herbaceous plant trailing or climbing from 1.5 – 4.5 m (5 to 15 ft.) by means of simple tendrils. Cucumbers are not suited to high mountain climates or very dry seasons. Daytime temperatures of no lower than 15° C (60°F), humidity of 80-90%, and rainfall of 100-200 mm (4-8 in) per month produce the best results, especially when grown in loose, well-drained soils amended with organic matter (ECHO Asia Seed Fact Sheet).
- Shoots and leaves, young and mature fruit (depending on variety) are all eaten.
- The shoots and leaves can be eaten as a vegetable in soups and stir-fried dishes. The fruit is usually peeled and eaten raw with dipping sauces or cooked as a vegetable in soups, curries, and stir-fried dishes.



Photo Credit: Kimberly B. Duncan

Cucurbita maxima & Cucurbita moschata

Squash/Pumpkin

ฟักทอง

Not yet available through the ECHO Asia Seed Catalog.

- Pumpkin is a vining annual that originated in North America, possibly Mexico, and is now widely distributed throughout the tropics. The vines will grow widely along the surface of the ground, rooting at nodes, or they may be grown on trellises or other supports. Pumpkins thrive in warm conditions and pumpkin vines need fertile, compost-rich, well-drained soil in full sun. (ECHO Florida Seed Fact Sheet). The maxima species contain varieties that have pumpkin-like fruit but the skin is usually more yellow than orange and the stems are soft and spongy or corky (HortAnswers 2015).
- The shoots and leaves are sweet and tender, and the mature gourd fruit is sweet.
- The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The gourd fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs. The seeds are roasted and eaten as a snack, or pressed for oil.



Lagenaria siceraria
Bottle Gourd, Calabash

น้ำเต้า

Available from the ECHO Asia Seed Catalog.

- Bottle gourd is a vining annual that grows up to 30 feet in length and is grown throughout Asia for its edible shoots, leaves, and fruit. It is generally best-suited for semi-dry areas but is found throughout sub-tropical and tropical environments and grows best in well-drained, loose soil with a good layer of compost. (ECHO Asia Seed Fact Sheet).
- Bottle gourd shoots, leaves, and young fruit are mild-tasting vegetables.
- Shoots, leaves, and fruits are eaten as a vegetable in soups, curries, and stir-fries. They can be easily added to dishes that have stronger-tasting vegetables. Shoots and leaves of the Cucurbitaceae family can be easily stir-fried or steamed with garlic, oyster sauce, and fermented soybeans for a tasty vegetable side dish.

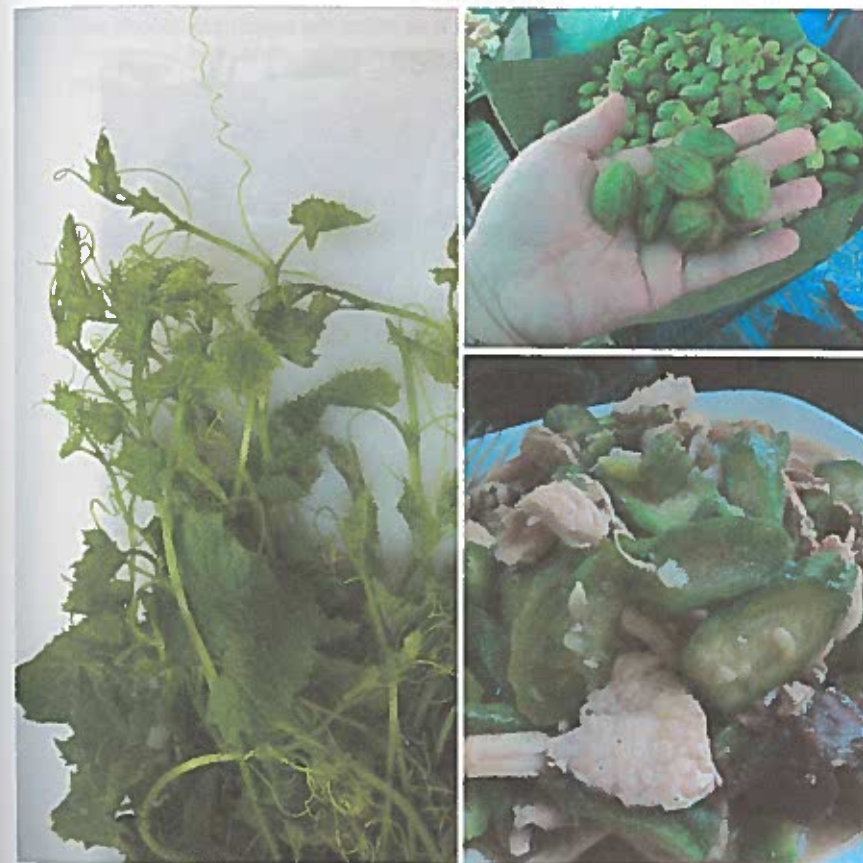


Luffa cylindrica
Smooth Luffa Gourd

ขี้เหล็ก

Available from the ECHO Asia Seed Catalog.

- Luffa is a climbing annual that when mature, produces oblong fruit about 30 cm (1 ft) long that are full of fiber and oval, black seeds. Luffa generally grows well wherever cucumbers thrive but prefers well-drained, fertile soil. (ECHO Asia Seed Fact Sheet).
- The shoots and leaves are sweet and tender, and the young fruit is mild-tasting.
- The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The peeled fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs.



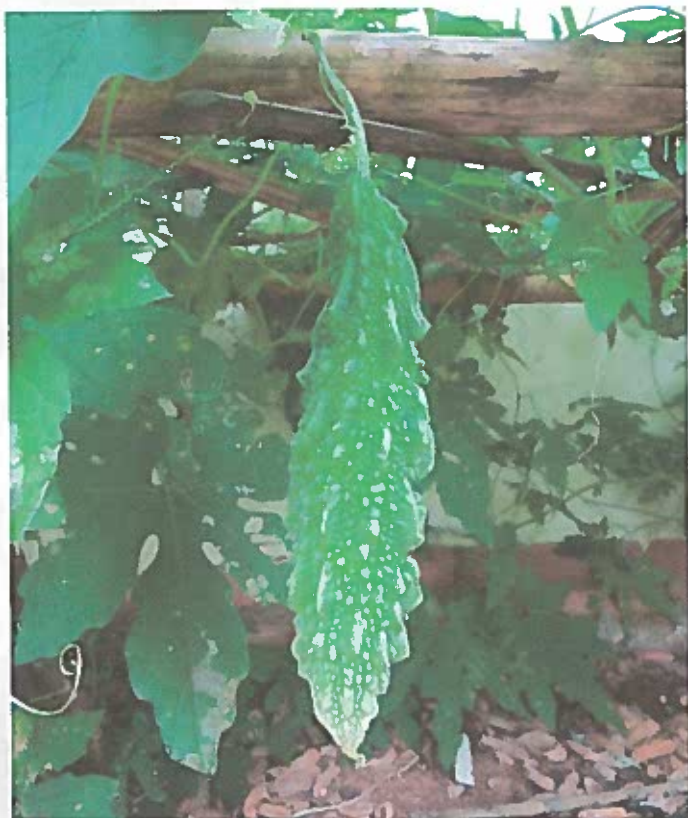
Momordica charantia

Bitter Melon

מורכר (Variety in ECHO Seed Bank)

Available from the ECHO Asia Seed Catalog.

- Bitter gourd is an annual vine that prefers well-drained, sandy loam soil but will grow in areas with poorer soils. It produces edible tender vine tips that are rich in vitamin C and calcium, and immature fruits that have folic acid and vitamin C (ECHO Asia Seed Fact Sheet).
- Shoots are edible year-round while the immature fruits are best harvested during hot season for consumption.
- Shoots and fruits are eaten as a vegetable in soups. Bitter gourd stuffed with minced pork and added to pork bone broth is a classic Thai dish. Sautee with onions and add to omelettes for a quick and tasty meal.



Trichosanthes cucumerina

Snake Gourd

קנורט

Not available from ECHO Asia.

- Snake gourd is indigenous to South and SE Asia, and has a habit very much like cucumber or pumpkin. It is best grown on a trellis for supporting the snake-like fruits and providing ample amounts of sunlight. It can be grown in the tropics and sub-tropics at elevations up to 1,500 meters, and it grows best in areas where annual daytime temperatures are within the range 22 - 35°C, but can tolerate 14 - 38°C. It prefers a mean annual rainfall in the range 2,000 - 2,500mm, but tolerates 700 - 4,200mm and it grows best in a rich well-drained soil with plenty of moisture in the growing season (HEAR.org 2012).
- The shoots and leaves are sweet and tender, and the young fruit is mild-tasting.
- The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The peeled fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs.

Euphorbiaceae Family

Cnidoscolus aconitifolius

Chaya, Tree Spinach

ชaya

Available as ECHO cuttings.

- Chaya is a fast-growing perennial shrub native to Mexico that produces many attractive, large, dark green leaves. It can grow well on a wide range of soils in both hot, rainy climates and areas with occasional drought. It grows easily and quickly, especially at higher temperatures, and new leaves grow quickly after harvesting (TN Chaya 2006).
- Chaya has sweet-tasting leaves and shoots, and crunchy stems that are similar to broccoli stems in texture. Its leaves are rich in protein, calcium, iron, carotene, riboflavin, niacin and ascorbic acid.
- Chaya is a versatile food plant that can be eaten as a dipping vegetable with chili pastes, added as a vegetable in stir-fries and curries. The chewy texture of its leaves is similar to cassava, cassod tree, and papaya leaves.



Manihot esculenta

Cassava

มันสำปะหลัง

Not available from ECHO Asia.

- One of agriculture's oldest crops, cassava is native to South America and is primarily grown as a perennial orchard and field crop species. Attaining heights of 1-5 meters, it is propagated from stem cuttings and is tolerant of acid soils, making it a well-suited crop for smallholder farmers of the tropics (FAO 2013).
- Cassava tubers are primarily eaten for calories and are otherwise considerably deficient in nutrition. There is high protein content in young leaves but amino acid content is unbalanced, especially methionine. Possesses good quantities of Vitamin B, phosphorus, and iron. Cooked cassava leaves have a mild spinach flavor.
- Cassava greens are eaten as a dipping vegetable in the Padang culture in Indonesia. After blanching, the greens can be cooked with shallots, galangal and coconut milk for a sweet-savory side dish. Cassava tubers can be boiled, steamed, fried, or fermented and prepared into a flour. Brazilian food showcases breads and pancakes made from cassava flour.



Sauropus androgynus

Katuk; Sweet Leaf

ผักหวาน

Available as UHDP cuttings.

- Katuk is indigenous to SE Asia and very often found planted in home vegetable gardens, where it can adapt well to varying amounts of shade. The shoots of katuk are produced throughout much of the year, particularly with the availability of moisture. One productive bush can offer several edible shoots at a time, making it a very good perennial food source with very little effort involved (Burnette et al. In Press; UHDP 2006).
- The shoots and leaves are nutty tasting with a chewier texture than other greens.
- The leaves are eaten raw in salads, or added to soups and stews as a vegetable. The juice from leaves can be extracted.



Fabaceae Family

Acacia concinna

Shikakai, Soap Pod Acacia

สบู่ดำ

Not available from ECHO Asia.

- Soap Pod is a quick-growing, climbing shrub native to Asia. It is a nitrogen-fixing tree when the correct bacteria are present in the soil and is adaptable to many different types of habitats (Useful Tropical Plants Database 2015).
- The shoots and leaves of this acacia variety can taste as sour as limes.
- The shoots and leaves can be eaten raw or added to soups and stews to give a sour flavor. This variety of acacia pairs well with fish dishes.



Acacia pennata

Acacia (Cha-om)

ชะอม(Central)/ผักหวาน(Northern)

Not available from ECHO Asia.

- Acacia is an indigenous forest species native to SE Asia which grows well in an agroforestry setting with various amounts of shade. It tolerates many different growing conditions, and the small tree handles coppicing well to produce more young shoots and leaves (UHDP 2006).
- The edible shoots and leaves have a sulfurous, garlicky taste, which can be considered an acquired taste. According to ECHO Asia staff, shoots harvested during dry season have the best flavor.
- Eaten as a vegetable in soups and stir-fried dishes. Northern Thai enjoy acacia vegetable soups generously flavored with fermented shrimp or fish paste. Pairs well with pickled garlic in omelettes for an easy meal. Acacia omelettes commonly eaten with fermented shrimp chili pastes or fiery southern Thai sour shrimp soup.



Cajanus cajan

Pigeon Pea

ถั่วเขียว(Central)/ถั่วแระ(Northern)

Available from the ECHO Asia Seed Catalog.

- Pigeon pea is a perennial, tree-like shrub that grows to 1.2 – 3.1 m (4-10 ft) tall and is used for food and fodder as well as in agroforestry systems. Originally from India, but now grown throughout the tropics, it produces dark green leaves and green, edible pods with seeds that are high in protein. Generally considered drought-resistant, pigeon pea can be grown on a wide range of soil types, and optimum average temperatures range from 18–29°C where annual rainfall ranges from 500-1,500 mm (20-60 in) a year (ECHO Asia Seed Fact Sheet).
- Pigeon pea seeds and pods have a distinctive taste - nutty and sweet. The seeds have a mealy texture when cooked.
- The dried mature seeds are used as a legume and can be cooked mixed with rice. The whole or split legumes can also be prepared as a stew or porridge. The young seed pods can be blanched and eaten as a dipping vegetable.



Canavalia gladiata

Sword Bean

ถั่วดาบ

Available from the ECHO Asia Seed Catalog.

- Sword bean is known chiefly as a cultivated species and may have been derived from a wild species occurring principally in Africa, but is now found throughout South and SE Asia. It thrives in tropical climates exhibiting moderately high temperatures (15-30°C/59-86°F). Preferred environmental conditions are found in the humid lowlands, but these beans may be grown with success in elevations to 1000 m (3000 ft), and are well-adapted to growth and survival in low-quality soils (ECHO Asia Seed Fact Sheet).
- The immature seeds are starchy like potatoes with a similar flavor. The young seed pods have a similar taste and texture to green beans.
- The young seed pods can be blanched and eaten as a dipping vegetable, or stir-fried as a vegetable. The immature seeds are starchy like potatoes - boil whole and remove the starchy interior. Eat mashed or whole in a similar fashion to jackfruit seeds.



Lablab purpureus

Vegetable Lablab Bean

ถั่วเนปoleanี

Available from the ECHO Asia Seed Catalog.

- Vegetable lablab is a climbing, perennial (or semi-perennial) legume commonly grown in gardens for edible purple pods; the use of manure, irrigation, and supports in home gardens will improve productivity. It is remarkably adaptable, growing in various climates and regions with annual rainfall ranging from 200 to 2,500 mm (8-98 in) and elevations ranging from sea level to 2,133 m (7,000 ft). As a nitrogen fixer, it can grow in many types of soils with a pH varying from 4.4 to 7.8 (ECHO Asia Seed Fact Sheet).
- Young lablab seed pods taste like green beans, with a chewy-crisp texture. Mature seeds are roasted to give a nutty taste. The flowers and leaves are also edible.
- The mature seeds are roasted and eaten as a beer snack. The green pods can be stir-fried or blanched and eaten as a dipping vegetable.



***Leucaena diversifolia*/Leucaena leucocephala**

Ipil Ipil

กระถิน

Available from the ECHO Asia Seed Catalog.

- *Leucaena diversifolia* is a multi-purpose 3-20 m tall tree species originally found in Central America but has become naturalized throughout many parts of the world. In the tropics, *Leucaena diversifolia* grows in areas from 700-2500 m altitude and is found in cool and seasonally wet locations with an average annual rainfall of 600-2800 mm and a mean maximum temperature in the hottest month of 18-30°C. In addition to its culinary uses, it can also be used for fixing nitrogen for soil improvement, reforestation projects, livestock fodder, as a windbreak or countour hedgerow plant in such applications such as SALT, and as a paper or fuelwood (ECHO Asia Seed Fact Sheet).
- The young shoots and leaves are slightly bitter tasting. The young seed pods can taste like green beans. Mature seeds can be made into a fermented product called tempeh that is rich in protein.
- The shoots and leaves can be blanched and eaten as a dipping vegetable, or added to soups, stews, and stir-fried dishes. The young pods are blanched and eaten as a dipping vegetable.



Photo Credit: Kimberly B. Duncan

Psophocarpus tetragonolobus

Winged Bean

กระถิน

Available from the ECHO Asia Seed Catalog.

- Winged bean is a climbing perennial with large pale-blue flowers that produce 15-20 cm (6-8 in) winged pods at maturity and is widely distributed through the tropics and subtropics. Planted at the beginning of the rainy season, it grows in the tropics at elevations up to 2100 m (6,890 ft). It thrives in hot, wet climates, although a dry period is favorable to fertilization and the production of mature pods. It will grow under a variety of soil conditions except in sand or high salinity (ECHO Asia Seed Fact Sheet).
- Young winged bean seed pods are crisp and taste somewhat like asparagus. The mature seeds and young leaves are also edible.
- The young green pods are eaten raw or blanched as a dipping vegetable or sliced thinly for salads. The leaves can be cooked and eaten as a vegetable.



Photo Credit: Kimberly B. Duncan

Photo Credit: Kimberly B. Duncan

Senna siamea

Cassod Tree

ขี้เหล็ก (Khi lek)

Available from the ECHO Asia Seed Catalog.

- Cassod is an indigenous forest species native to SE Asia which grows well in an agroforestry setting with various amounts of shade. It tolerates many different growing conditions, and the small-medium sized tree grows very quickly, making it well-suited as a nurse species for shade-loving trees and as a fuelwood source in addition to its edible qualities (UHDP 2006).
- Cassod tree shoots and leaves have a bitter taste favoured in Northern Thailand, while its flowers are slightly garlic tasting.
- Like cassava greens, blanched cassod tree greens can be prepared with shallots, galangal, chilies, and coconut milk for a curry commonly eaten in Northern Thailand. The greens can also be eaten as a dipping vegetable.



Sesbania grandiflora

Sesbania

แตงแดง/ดอกแค/แคบ้านดอกแดง (Dok Khae)

Available from the ECHO Asia Seed Catalog.

- Sesbania is a small, quick-growing, loosely-branching tree with compound, alternate leaves. It is well adapted to hot, humid environments and does not grow well in the subtropics with cool temperatures below 10°C (50°F). It is tolerant of a high variety of soil types, including heavy and very poor soils, and useful as a nitrogen fixing plant for soil improvement, high-quality livestock fodder, as a hedgerow or windbreak, and for pulp and paper production (ECHO Asia Seed Fact Sheet).
- Sesbania flowers are slightly bitter and the immature seed pods are edible.
- The flowers can be eaten raw or blanched as a dipping vegetable or added to salads, soups and curries, and stir-fried dishes. The young pods can be eaten as a vegetable in a similar fashion to green beans.



Photo Credit: Kim

Tamarindus indica

Tamarind

تامارند

Not available from ECHO Asia.

- Tamarind (*Tamarindus indica*) is a tree that grows throughout the tropics and is valued in Northern Thailand, as elsewhere, for its pulpy pods, tender leaf shoots, and flowers, which are used in a variety of dishes. This tree can be found in backyard gardens, in orchard settings, as well as in hill fields. It is well-adapted to semi-arid tropical conditions, although it does well in many humid tropical areas of the world with seasonally high rainfall and grows well in deep, well-drained soils that are slightly acid (ECHO Florida Seed Fact Sheet).
- The unique sweet-sour flavor of tamarind fruit pulp is prized in Southeast Asia. The green immature fruits are mild-tasting while the shoots and leaves are sour.
- The shoots and leaves have a pleasing tart flavor and can be eaten raw in salads or used to add sour flavor to soups and stews. The immature and mature fruits are eaten as a fruit snack. Immature fruits can be pounded into spicy chili pastes. The dark brown pulp from mature pods are used to flavor curries and stews, or mixed with sugar to make drinks and sweets.



Vigna radiata

Mung Bean

mung bean

Available from the ECHO Asia Seed Catalog.

- A bushy or viny annual that produces yellow flowers and pods up to 15 cm (6 in) in length. Mung bean is an important grain legume crop throughout Asia for its use as food, an intercrop with rice, and as a green manure and fodder. It grows mainly within 20-40° C (68-104°F) and up to altitudes of 2000 m (6,562 ft) in the tropics. Easy to grow in a wide range of soil types, it prefers well-drained loams or sandy loams with a soil pH range of 6.2-7.2 (ECHO Asia Seed Fact Sheet).
- Mature seeds can be boiled whole with rice or by itself to make a hearty porridge.
- The dried mature seeds are used as a legume and can be cooked mixed with rice. The whole or split legumes can also be prepared as a porridge.



Vigna umbellata

Rice Bean

ถั่วแดง(Central)/ถั่วเนป(Northern)

Available from the ECHO Asia Seed Catalog.

- Rice bean is a twining annual with yellow flowers and edible beans that can also be grown as a semi-perennial. There are both climbing and bush types of rice bean, and it is commonly grown for food, as fodder, and intercropped with rice, corn, sorghum, and cowpea in the upland tropics. Rice bean is adapted to regions with 1,000–1,500 mm (39-59 in) precipitation, is tolerant of high temperatures and high humidity, and can tolerate diverse soil conditions (ECHO Asia Seed Fact Sheet).
- Mature seeds and young pods are edible.
- The dried mature seeds are used as a legume and can be cooked mixed with rice.



Photo C

Vigna unguiculata ssp. Sesquipedalis

Asparagus Bean, Yardlong Bean

ถั่วฝักยาว

Available from the ECHO Asia Seed Catalog.

- Yard long bean most likely originated in southern China and is a legume closely related to the common cowpea, which is typically cultivated for its edible immature pods between 30 and 90 cm in length. It thrives in hot humid climates, preferably with full sunlight, with daytime temperatures of 20-35°C, and may begin fruit production as early as 7 weeks after planting. It will tolerate acidic and relatively poor soils and low-moisture environments, but prefers deep, fertile, well-drained loam and will benefit from trellising (ECHO Asia Seed Fact Sheet).
- Immature seed pods and seeds have a strong bean-like flavor and a tender-crisp texture when stir-fried. The young leaves are also edible.
- The long pods are eaten raw or blanched as a dipping vegetable or in salads. They can also be pounded into chili pastes for a rustic side dish. Best stir-fried, the mild-tasting cooked pods lose their bright green color and soften excessively. Young leaves are eaten cooked as a vegetable.



Photo C. Photo: Kanchana B. Duncanson

Malvaceae Family

Abelmoschus esculentus

Okra

กระเจี๊ยบเขียว

Available from the ECHO Asia Seed Catalog.

- Okra is an upright annual about 1 to 2 m (3 to 6 ft) tall with a main stem and several branches. It is a prolific producer of dark green pods that can be harvested continuously for weeks. It needs full sunlight on fertile, well-drained soils, in hot climatic conditions (ECHO Asia Seed Fact Sheet).
- Young okra pods can be harvested continuously from the plant. They are mild-tasting and mucilaginous, less when raw and more so when cooked. This may or may not appeal to some people! The leaves are sour, like those of the roselle plant.
- The young pods can be eaten raw or blanched as a dipping vegetable with spicy relishes. If stir-fried or added to soups and stews as a vegetable, the pods add a mucilaginous texture to the dish. Add cumin, salt or lime juice to reduce the mucilage.



Hibiscus sabdariffa

Roselle

กระเจี๊ยบ/กระเจี๊ยบแดง

Available from the ECHO Asia Seed Catalog.

- Roselle is a tall, slightly bushy perennial plant with red stems, leaves and succulent calyces. It is suitable for tropical climates with well-distributed rainfall of 1500–2000 mm yearly, from sea-level to about 600 m altitude, and can adapt to a wide-range of soil types. One thing to note is that Roselle is a short-day plant; it will not flower when days are over 13 hours (ECHO Asia Seed Fact Sheet).
- The young leaves are slightly mucilaginous, sour in flavour and mildly reminiscent of rhubarb. The young calyces are sour.
- The leaves can be sundried or used fresh to add a sour flavour to soups and stews or spicy relishes. The dried or fresh calyces are boiled to make an acidic but refreshing drink. Fresh calyces can be used as a substitute for cranberries in Western recipes.



Moraceae Family

Ficus racemosa

Cluster Fig

มะเดื่อชุมพร(Central)/มะเดื่อ(Northern)

Not available from the ECHO Asia.

- Cluster fig is an indigenous forest species native to SE Asia which grows well in an agroforestry setting with various amounts of shade. It tolerates many different growing conditions, and the medium-large sized tree produces new shoots and leaves during the dry season when very few other edible plants may be productive. It has traditionally been used mainly for household-level consumption in N. Thailand (UHDP 2006).
- The shoots and leaves are astringent and sour, and the immature fruits are sour.
- The shoots and leaves must be blanched to reduce latex and to reduce its astringent flavour. Once blanched, the leaves can be eaten as a dipping vegetable, added to soups and stews as a vegetable. The immature fruits can be eaten fresh.



Ficus virens

Fig Leaf, Red or White

เผือก(Central)/เผือกเขิน(Northern)

Not available from the ECHO Asia.

- Red or white fig is an indigenous forest species native to SE Asia which grows well in an agroforestry, home garden, or mixed orchard setting with various amounts of shade. It tolerates many different growing conditions, but grows best in moist tropical lowlands, and the medium sized tree produces new shoots and leaves during the dry season when very few other edible plants may be productive. It has traditionally been used mainly for household-level consumption in N. Thailand. (UHDP 2006; Burnette et al. In Press).
- The shoots and leaves are astringent and sour, and the immature fruits are sour.
- The shoots and leave can be blanched and eaten with spicy dipping relishes or in a salad, or added to soups and stews as a vegetable. The immature fruits can be eaten.



Moringaceae Family

Moringa oleifera

Moringa

มoringa

Available from the ECHO Asia Seed Catalog.

- The moringa tree is a drought resistant, fast growing, deciduous tree or shrub with an average height of 12 meters (39.4 ft.) at maturity. Very easy to grow in many parts of the world, Moringa grows best between 25 to 35°C (77-95°F), but will tolerate up to 48°C (118°F) in the shade and can survive a light frost; however, it will not survive prolonged flooding or poorly-drained soil. Besides its human nutrition, Moringa can be used for living hedges, fences, and windbreaks; as paper pulp; as an animal fodder or nutritional supplement for livestock; and its seeds for water purification (ECHO Asia Seed Fact Sheet).
- Moringa shoots and leaves have a delicate nutty flavour, and the flowers are mild-tasting. Immature seeds are sweet and bitter; the fibrous seeds pods have an asparagus flavour, and the roots have a sharp horseradish taste.
- Shoots, leaves and seed pods are added to soups and stews as a vegetable, or eaten blanched or raw with dipping sauces. The seed pods are fibrous but still edible. Seeds may be pressed for oil which has a nutty flavour.



Musaceae Family

Musa x paradisiacal

Banana

กล้วย

Not available from the ECHO Asia.

- Banana is a versatile plant, with surprisingly edible hearts of the stem and flower blossoms, after removing its outer layers. Like leaves of ginger plants, banana leaves are commonly used for imparting flavour if wrapped food are grilled.
- Wild forest banana stems and blossoms have a delicate, floral flavour. Domesticated varieties are edible as well. If commonly eaten in your area, ask community members which varieties they prefer as some varieties are less appealing than others.
- Stem hearts are eaten as a vegetable in soups, particularly in the Burmese noodle soup made with catfish called mohinga. Flower hearts can be blanched and eaten in salads.



Piperaceae Family

Piper sarmentosum

Leaf Pepper

ขี้พริก(Central)

Available as UHDP cuttings.

- "A space efficient vine, leaf pepper can grow quickly under heavy shade, utilizing other trees for support. Grows well in an agroforest or home garden setting. This non-woody perennial is indigenous to the forests of Thailand, and is valued as both a food source and an ornamental ground cover. (UHDP 2006; Burnette et al. In Press)."
- Shoots and leaves have a slightly peppery and soapy taste that gives dishes a distinct flavour.
- Leaf pepper can be added to soups and stews for flavouring. The whole leaf can be used to wrap other edible ingredients for a savoury snack. The woody stem is frequently used to add a warm, peppery flavour to upland stews.



Harvesting and Cleaning Plants

Harvesting Shoots, Tips, and Leaves

- Choose healthy-looking shoots, tips and young leaves.
- Using fingers or a knife, remove the tips where the stem snaps off naturally or is easily cut through.
- Usually the shoots and tips are different colours from older leaves.



Cleaning Shoots, Tips, and Leaves

- Some plants require more effort in cleaning than others.
- **Cucurbitaceae** (top and bottom left images): tender stems and are edible. Peel off tough outer layer from the stem.
- **Red fig leaf** (bottom right image): remove white leaf sheath at the base of the edible reddish-brown leaves.



Cleaning Edible Hearts of Shoots, Flowers, and Stems

- **Rattan and fishtail palm** require removal of hard leaf sheaths in order to access the tender edible inner core.
- **Banana stem** require removal of tough outer layers (top image). The inner core of the stem is edible (bottom image).
- **Banana flower blossoms** have an edible inner heart. Remove the multiple layers of petals and immature flowers to access the creamy pale yellow heart.



Reducing Bitterness and Preventing Browning by Soaking in Water

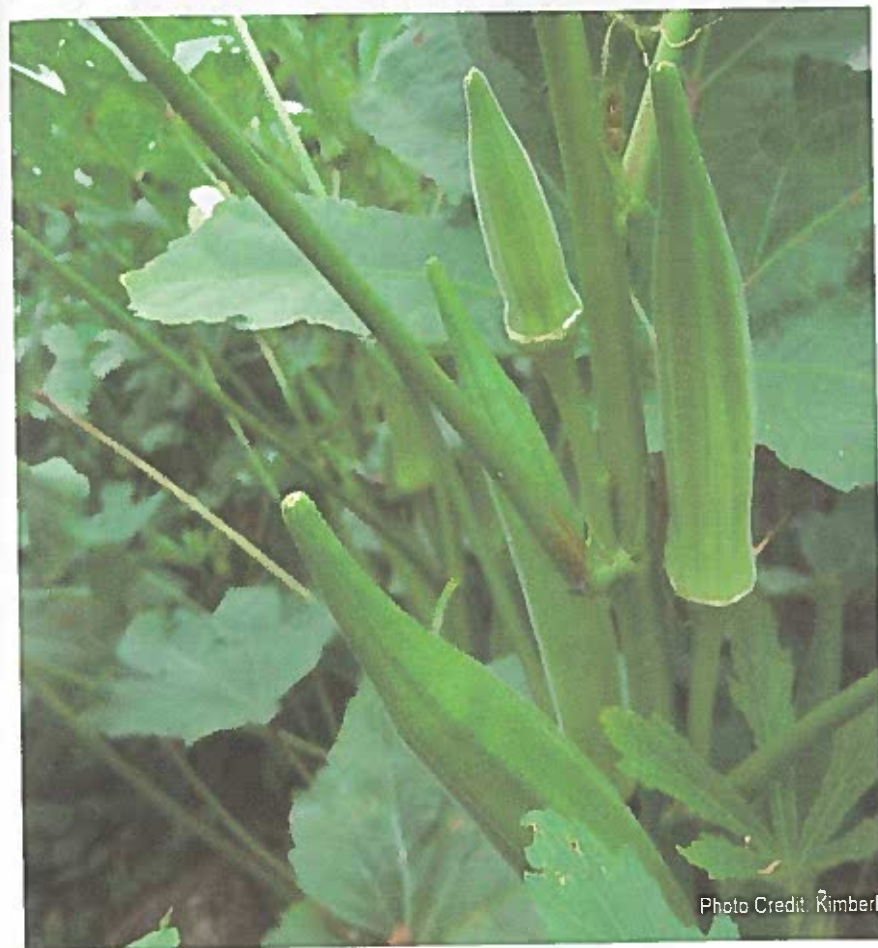
To prevent browning or oxidation:

- Banana stem and flower heart soaked in water with salt, lemon or buttermilk added
- Fishtail palm
- To reduce bitterness:
- Indian trumpet
- Rattan
- Bitter melon



Harvesting Young Fruits and Seed Pods

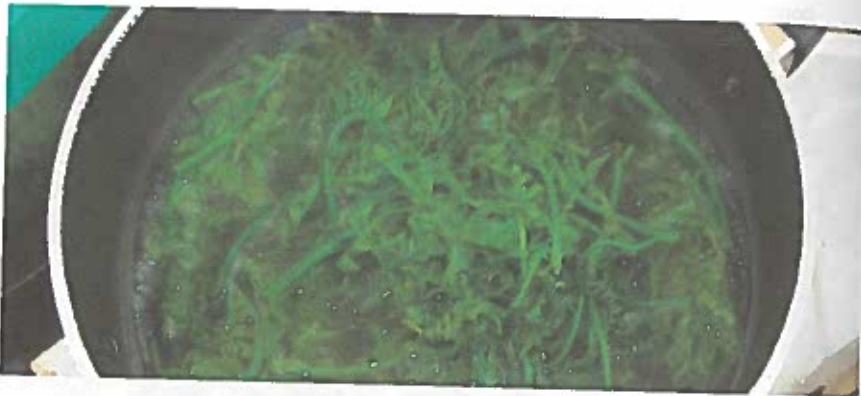
- Depending on the plant, seed pods and young fruits may be produced at different times and can be continuously harvested.
- Ask for advice from local community members about when to harvest fruits and pods.
- Okra flowers and produces edible seed pods continuously but only very young pods (arrow) are consumed. The older pods are too woody and tough to eat.
- Most varieties in the legume or Fabaceae family produce young seed pods for consumption.



Removing Toxins and Latex by Blanching in Boiling water

Some plants contain toxic properties that can be removed by blanching in boiling water for at least 10 minutes. The water should then be thrown out and not reused. Examples include chaya, cassava, and young sword bean pods.

Other plant varieties contain latex that may taste too astringent or cause upset stomach aches. Plants such as cassod tree shoots, Chiang Daa, and cluster fig can also be blanched in boiling water for at least 10 minutes to remove the latex.



Diversity and Eating in Moderation

Eating a wide variety of plants and in moderate amounts ensures that a diversity of nutrients is consumed during each meal and helps to minimize accumulation of compounds that may have negative health effects.



Food Preparation Methods

Preparation: Stir-fried or Steamed Vegetables

- Fast, easy method that uses less fuel than boiling or grilling
- Use minimal oil to stir-fry or water in a pot with lid to cook vegetables with steam

Cooking with Eggs

- Add shoots, leaves and flowers to eggs for a quick and nutritious meal eaten with rice

Curries, Stews, and Vegetable Soups

- Diverse mixtures of vegetables can be prepared with this method
- May require more fuel than stir-frying
- Use enough water to cover the vegetables in a pot and season with a variety of ingredients (please see recipes)

Salads

- Vegetables are blanched in boiling water but not always cooked fully
- Regional ingredients such as sesame in upland areas or fermented shrimp paste in lowland areas are used to prepare salad dressing

Dipping Vegetables

- Spicy chili pastes or relishes usually accompany every meal
- Vegetables are blanched or eaten raw, dipped in the relish



Neglected and Underutilized Species Recipes

Baby Pumpkin and Calabash Gourd with Seasoned Minced Pork

With a flavour like zucchini and a crunchy texture, baby pumpkin gourds can be sautéed with baby calabash gourd for a fast and easy vegetable side dish.



Preparation time: 5-10 minutes.

Cooking time: 15-20 minutes, depending on your heat source.

Serves: 3-4 people, with rice.

Ingredients:

- 1 small baby calabash gourd, cut into quarters and then thinly sliced (about 1 to 1 and ½ cups; see Note)
- 1 small baby pumpkin gourd, cut into quarters and then thinly sliced (about 1 to 1 and ½ cups)
- 100 g minced pork
- 1 tsp soy sauce*
- 1 tsp oyster sauce
- 2-3 tsp oil

**If salt intake is a concern, reduce the amount of sauces used according to preference*



Minced together or pounded together with a mortar and pestle:

- 2-4 fresh chilies
- 2-6 cloves garlic
- 2-3 shallots
- Water

Directions:

1. In a small bowl, season the minced pork with soy sauce and oyster sauce. Set aside.
2. Heat oil in a frying pan at medium heat and add the chilies, garlic and shallots, stirring until the mixture is fragrant. Be careful not to burn the garlic.
3. Cook the pork mixture with the chilies, garlic and shallots, stirring until the meat is cooked through and no longer pink. Add the sliced baby gourds to the pan, making sure that all the pieces are coated with the pork and chilies. Reduce the heat to medium-low level.
4. Sprinkle the mixture with a few spoons of water to moisten everything and then cover with a lid. Steam will be produced that will help cook the baby gourds more thoroughly but be careful to only add a little water at a time or the dish will be too watery. You can omit this step if you prefer a drier dish – be careful to stir frequently to prevent the vegetables from sticking to the pan and the edges from burning.
5. Remove from heat when the baby pumpkin flesh has turned a deeper yellow and its skin a deeper green, and the baby calabash flesh is translucent.
6. Serve with rice.

Note: Cutting the baby gourds into uniformly sized pieces will help you produce an evenly cooked dish. Remove the stem from the top of the gourd with a sharp knife. Slice the gourd in half and then into quarters. Thinly slice each quarter section to produce triangular shaped pieces.

Substitutions:

- Eggs are a great alternative to minced pork: Instead of preparing the pork seasoned with soy and oyster sauces, beat together 3 or 4 fresh eggs with 2-3 tsp fish sauce (or to taste, according to your preference). Sauté the chilies, garlic and shallots in oil over medium heat until the mixture is fragrant and the garlic is golden. Add the eggs and stir well until they are no longer glossy and runny. Then add the baby gourds and cook until they are translucent and tender.
- Other young gourd fruits from the Cucurbitaceae family can be used instead of baby pumpkin and calabash, except for wax gourd which is better suited for preparing soups. Bitter melon (soaked to reduce bitter flavour) and luffa are wonderful substitutes, while cucumbers are a surprising alternative. Ask and look for local varieties that are grown for cooking – the fruits are larger and may be sold mature, meaning that the skin has yellowed but the flesh is still suitable for preparing in stir-fried dishes or in curries.

Fresh Chiang Daa Vine Tips Braised in a Fish Broth

Fresh vegetables can be braised in savoury broths made from dried or smoked fish. Slightly bitter chiang daa vine tips are the star of this recipe, complemented by a broth made from dried fish found in the market. Different vegetables can be substituted with this method of cooking with a small volume of flavoured liquid so be creative!



Preparation time: Cleaning and removing shoots from the tougher stems could take up to 20 minutes.

Cooking time: 15-20 minutes, depending on your heat source. **Serves:** 3-4 people with rice.

Ingredients:

- 4 cups water
- 1 whole sundried or smoked fish* (can grill to bring out more flavour)



Pound together with a mortar and pestle or mince finely together:

- 5 whole dried chili peppers
- 4 cloves garlic
- 4 whole shallots
- 1 tbsp fermented fish paste
- 1 tbsp fermented shrimp paste
- 4 cups chiang daa leaves and shoots



Directions:

1. Boil water in a pot and place the fish in it to make the broth – let soften and then pull off meat from bones and skin. Discard bones and skins.
2. Flavour broth with pounded chilies, garlic, shallots and fermented pastes. Continue to simmer and let meat soften.
3. Taste and adjust seasonings.
4. Water should still be simmering. Add chiang daa vegetables and make sure to stir into the soup. Turn off the heat.
5. Serve.

Creamy Forest Banana Flower Heart Salad with Sawtooth Coriander and Sesame Dressing

The tear-dropped shaped flower blossom at the end of the forest banana fruit cluster can be made into a creamy and unique salad with a few ingredients. The cleaning process will take longer than the time taken to toss the salad and eat it, but if you can find wild forest banana flower blossoms, the floral taste is worth it!



Preparation time: 30-45 minutes, including soaking and massaging the hearts in salt water and preparing all the ingredients.

Cooking time: None.

Serves: Depending on the size of the heart after removing the inedible outer leaves and immature flowers, this dish can serve 1-4 people as a side dish.

Ingredients:

- 2 whole banana flower blossoms, shredded finely*

Prepare these ingredients and set aside:

- 4-5 shallots, finely sliced
- 1 tsp lime juice, to taste
- 2-3 tsp light soy sauce, to taste
- 4-5 leaves sawtooth coriander, finely sliced
- 3-4 tbsp sesame seeds, toasted* until golden brown and then pounded with a mortar and pestle



Directions:

1. Each flower blossom ("inflorescence") is made up of alternating layers of modified leaves ("bracts") and immature female flowers that will eventually develop into fruit. Peel away and discard each astringent-tasting bract and flower layer until you reach the edible flower heart that is creamy yellow.
2. Taste a layer of the edible heart – if it is still too astringent for your taste, continue to remove the layers until you reach the less astringent layers underneath. You should discard any brown flowers inside the yellow heart as they are bitter-tasting.
3. Finely slice the heart and immediately soak in salt water to prevent browning.
4. Massage the slices in the water by squeezing and releasing. Discard the brown water that is produced from massaging, and add more salt water. Massage again and then discard the water.
5. Before seasoning the banana heart, squeeze water out of the slices and then tease the pieces apart in a bowl. Add the shallots, lime juice and light soy sauce and mix well and adjusting the seasoning until all the pieces are coated well.
6. When you are satisfied with the taste, sprinkle with sesame and sawtooth coriander and mix well again.
7. Serve as a side dish in a complete rice meal.

Note: Choosing edible banana flower blossoms.



Herbal Fish Soup with Lemongrass and Lime Leaf

Sour fish soups are an excellent way to prepare fresh fish available from the waterways that zigzag throughout Southeast Asia. Fish should be fresh, not dried or smoked, when cooked with sour vegetables like somboey, young tamarind leaves or lime juice. Catfish is too earthy-tasting so it is not a good match. A generous heaping of fresh herbs brings all the flavours of this soup together. The less water used, the more vibrant the sour and herbal flavours!



Preparation time: 10-15 minutes.

Cooking time: 20-20 minutes.

Serves: 3-4 people, with rice.

Ingredients:

- 4 cups water

Smash with a pestle to release flavours:

- 2 pieces fresh lemongrass
- 1 piece fresh galangal, about 2 inches long
- 1 piece fresh turmeric, about half an inch or 1 inch long
- 450 g fresh snakehead fish (one medium whole fish), cleaned and cut cross-wise into 1-1.5 inch thick pieces
- Salt to taste

- 2 cups somboey* leaves and shoots, cleaned and removed from the stem
- 4-6 whole shallots
- 5 whole chilies (smash for spicier flavour or leave whole)
- 10-15 wild local tomatoes or cherry tomatoes
- 4-5 kefir lime leaves, torn



- ½ cup coriander leaves, chopped
- ½ cup sawtooth coriander leaves, finely chopped
- ½ cup green onions, finely chopped

Directions:

1. Place lemongrass, galangal, and turmeric in a pot with the water and bring everything to a boil. You should be able to smell the herbs quite strongly before adding the fish. The turmeric reduces the fishy flavor of the dish, so you can add more if so desired.
2. Add the fish to the water and let the water return to a gentle boil. Use a large spoon to skim off any brown scum that rises to the surface. Let the fish cook completely and to take on the flavors of the herbs in the soup.
3. Add enough salt to taste. I recommend putting salt into a bowl and mixing soup water with it, and adding the solution spoon by spoon to get the right level of saltiness.
4. When you are happy with the saltiness of the soup, add the somboey shoots and leaves, and stir them into the soup. The leaves will turn quickly from green to a dull brown.
5. Add the shallots, chilies, and tomatoes and let the water return to a simmer. If you like a sweeter tasting broth, add more shallots to balance out the sour and salty flavours.
6. Add the torn kefir lime leaves and keep the soup simmering. Once you can smell the scent of lime leaves rising up from the soup, remove from heat. It is difficult to over-cook kefir lime leaves so do not worry about that!
7. Before serving, generously sprinkle the soup with chopped coriander, sawtooth coriander, and green onions and stir it all in. These herbs add another layer of wonderful flavor to this dish.
8. Serve with rice!

Substitutions:

- If you cannot find fresh snakehead fish, you can substitute tilapia or any other fresh water river fish. This soup is also good with shrimp.
- If you cannot find *Acacia concinna* or somboey around where you live, you can substitute the following: 2 cups young tamarind leaves and juice of 1-2 limes (or to your taste preference)

Fern Frond Salad with Toasted Sesame, Tomatoes, and Shallots

Growing alongside forest streams and flourishing in the shade, ferns are a surprisingly versatile vegetable. It can be sautéed easily but this recipe presents a Lahu-style salad using toasted sesame seeds, lime juice, and fresh shallots to dress the fern fronds.



Preparation time: 10-15 minutes, including rinsing several times to remove the fine black hairs that may lead to itchy throats if consumed.

Cooking time: Approximately 60-90 seconds to blanch the ferns.

Serves: 3-4 people as a side dish in a complete meal.

Ingredients:

- 2 cups fern shoots and tips, cleaned*

Prepare these ingredients and set aside:

- 4-5 shallots, finely sliced
- 3-4 fresh chili peppers, finely minced
- 3-4 tbsp sesame seeds, toasted* until golden brown and then pounded with a mortar and pestle
- 2-3 tsp lime juice, to taste
- 2-3 tsp light soy sauce, to taste



Directions:

1. Quickly blanch the cleaned ferns in boiling water for 60-90 seconds and drain well.
2. In a large bowl, toss all the remaining ingredients together with the ferns and mix well.
3. Serve as a side dish

**Notes:* Young leaves and tips of ferns can be tightly rolled up in a fiddlehead ("crozier") or starting to unfurl. Pinch the edible tips off the stem with two fingers - if you are having difficulty removing the tips from the stem, pinch higher up the stem towards the shoot tip where the plant material is younger. The tips should break off easily.

Fern leaves will be covered in fine black hairs, which are inedible. Prepare a bowl of water before cleaning the ferns. As you pinch off the shoot tips, drop them into the water. When you have removed all the tips into the water, shake thoroughly and discard the water. Fill the bowl with water again and shake the shoot tips again in the water. Repeat this process until the water runs clear.

Toast sesame seeds in a dry pan over low heat, using a spoon or spatula to stir the seeds around frequently. As the oil inside the seed heats up, you may see some smoke rising up from the pan and hear popping sounds. Toast until the seeds are golden brown and then remove the seeds from the pan. Burned seeds will spoil the taste of the salad. Use a mortar and pestle to release the wonderful toasted sesame flavor, pounding the cooled sesame into a fine texture. Allow the sesame to cool first or you may end up pounding the seeds into a paste-like texture.

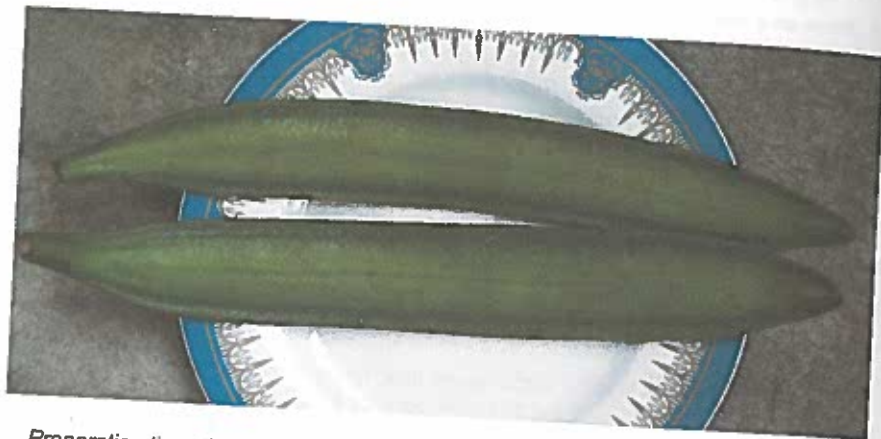
Substitutions:

- Sesame seeds or peanuts can be used in this recipe, depending on preference.



Stir-Fried Mildly Bitter Indian Trumpet with Savory Minced Pork

Indian trumpet pods taste like giant bitter green beans – once you soak them overnight in salted water, however, they are less bitter and delicious stir-fried with minced pork for an easy meal eaten with rice.



Preparation time: 12 hours soaking overnight.

Cooking time: 15-20 minutes, depending on your heat source.

Serves: 3-4 people, served with rice.

Ingredients:

- 1 whole Indian trumpet pod (about 2 cups, sliced ¼ inch thick, can be sliced thinner depending on preference)
- 1-2 tsp salt
- 100 g minced pork
- 1 tsp soy sauce*
- 1 tsp oyster sauce
- 2-3 tsp fermented soybean sauce* (Thai: เต้าเจี้ยว)

**If salt intake is a concern, reduce the amount of sauces used as the pods will taste salty after soaking overnight in salt water*

- 2-3 tsp oil

Minced or pounded together with a mortar and pestle:

- 2-4 fresh chili peppers
- 2-6 cloves garlic
- 2-3 shallots



Directions:

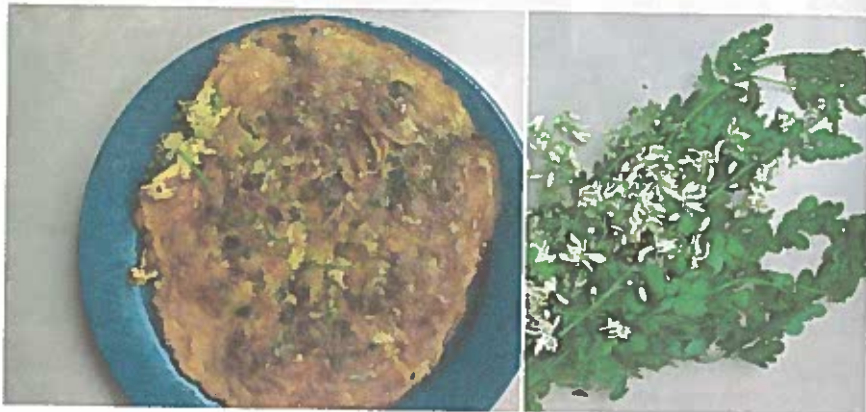
1. Slice pod cross-wise into ¼ inch thick pieces and place into a heat-resistant bowl. Pour enough boiling water to cover and add the salt. Soak overnight to reduce bitter flavor. Discard soaking water when ready to cook the vegetables.
2. Season the minced pork with soy sauce, oyster sauce, and fermented soybean sauce. Set aside.
3. Heat oil in a frying pan at medium heat and add the chilies, garlic, and shallots, stirring until the mixture is fragrant. Be careful not to burn the garlic.
4. Cook the pork mixture with the chilies, garlic, and shallots, stirring until the meat is no longer pink. Now add the indian trumpet slices and cook over medium heat until the slices turn a light brown and the pork is no longer pink.
5. If you like a tender-crisp vegetable texture, remove from heat when the indian trumpet is still slightly green. Serve with rice.

**Note:* Fermented soybean sauce (เต้าเจี้ยว) can be easily found in local markets in Thailand. It has a salty flavor and is commonly added to Chinese-Thai food. If it is not available where you are, it can be omitted.



Quick and Easy Moringa Leaf and Blossom Omelette

Moringa omelettes are a quick and delicious way to add a highly nutritious vegetable to your everyday meals. The flower blossoms are a surprising and unusual addition!



Preparation time: 5-7 minutes.

Cooking time: 7-10 minutes.

Serves: 3-4 people as a side dish with a complete rice meal.

Ingredients:

- 2 cups moringa leaves and blossoms, removed from stems and washed*
- 4 eggs
- 1 tsp soy sauce
- 2-3 tbsp oil

Directions:

1. First beat eggs in a bowl with soy or fish or oyster sauce or salt. Then add the moringa leaves and blossoms to the bowl and stir into the eggs until completely coated.
2. In a large frying pan, heat oil over medium heat. Drop a small amount of the egg mixture into the oil – the oil is hot enough when the droplets sizzles and cooks thoroughly.
3. Carefully pour the egg and moringa mixture into the hot oil. Wait for the edges of the omelette to dry up and turn golden brown, and for the center of the omelette to lose its wet sheen and have a more firm texture.
4. Turn the omelette over and cook through on the other side. Check the middle of the omelette and make sure it is completely cooked.

5. Serve with rice

**Note:* Moringa leaves and blossoms can be taken off easily by pinching the bottom of the stem (closest to where it was attached to the plant) and running fingers along towards the tip, pulling off leaves and blossoms at the same time.

Substitutes:

- Use fish sauce or oyster sauce if desired. Use a pinch of salt and 1 tsp of lime juice if soy or seafood sauces are not suitable. The lime juice helps omelettes fluff up while cooking.
- You can also use other vegetables with this method, combining 1 cup of vegetables with 2 eggs: acacia (cha-om), bitter melon fruits (sliced into half-moon pieces, soaked in salt water and drained before adding to eggs), or *Sesbania rostrata* flowers

Sour and Savory Northern Thai-Style Malabar Spinach Soup with Pork

This hearty vegetable soup features regional Thai ingredients, such as Isaan-style fermented fish paste from northeast Thailand, malabar spinach, fermented shrimp, fermented soybeans and soured pork from Northern Thailand. Squeezing lime juice into the dish just before serving reduces the usual slippery texture of Malabar spinach and adds a mouth-puckering tang.



Preparation time: 25 minutes, including approximately 5 minutes to grill a disk of fermented soybean paste.

Cooking time: 15-25 minutes, depending on heat source.

Serves: 4-6 people as a side dish with a complete rice meal.

Ingredients:

- 5 cups water

Pound with mortar and pestle or mince finely, and combine together:

- 4-5 fresh chili peppers
- 5 small cloves garlic
- 4 small shallots
- 1 disk fermented soybean paste (ถั่วเน่า), about 3 tbsp after grilling* and pounding into a fine powder
- 1 tsp fermented fish paste (ปลาร้า)
- 2 tbsp fermented shrimp paste (กะปิ)
- 3 cups Malabar spinach leaves, shoots and flowers
- 80 g soured pork (หมูหมัก)
- 1 lime, squeezed for juice

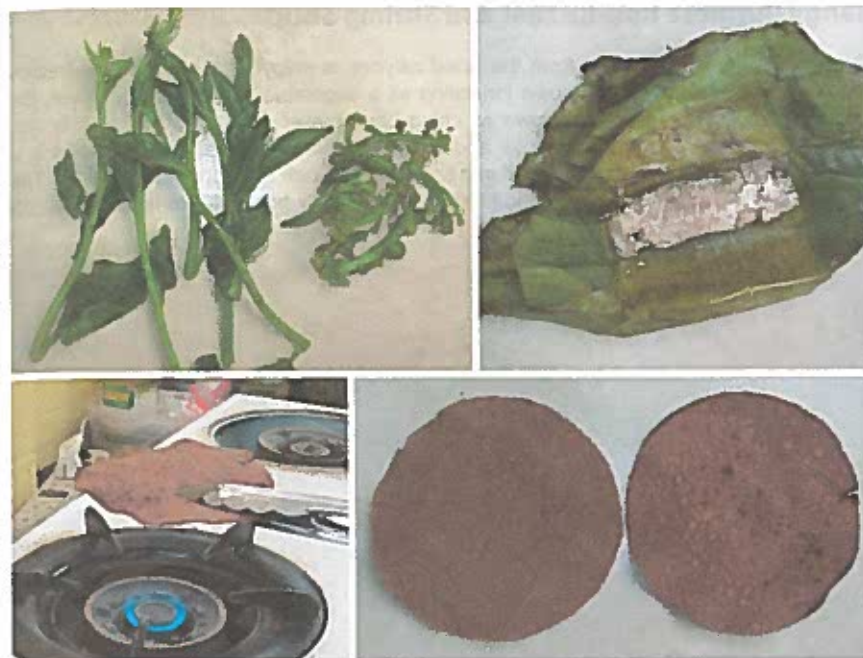
Directions:

1. Bring water to a boil in a large pot and then add the pounded or minced chilies, garlic, and shallots.
2. Add the fermented soybean paste. In a separate bowl, mix together some of the cooking water with the fermented fish and shrimp pastes and use a spoon to break apart any lumps; this helps to produce a smooth seasoning liquid.
3. Reduce heat to medium- low and add the Malabar spinach to the cooking water. Bring the water to a simmer; the color of the vegetable will turn from green to dull brown as it cooks.
4. Add the soured pork once the vegetables turn brown and continue to simmer on low heat.
5. Pinch the stems of one of the shoots to check whether it is cooked through – it should be tender but easily squeezed into a mush. When you have achieved this texture, remove the soup from heat immediately. If cooked for too long, the Malabar spinach will lose its shape and turn into an unappetizing mush.
6. Squeeze lime juice into the soup before serving, according to taste.

Notes: Bird's eye chilies are preferred in this recipe, as they give an appetizing spiciness to the soup

Use small cloves of local garlic if available; these are smaller and tastier than larger varieties usually imported from China and found in larger markets

Fermented ingredients are essential for adding "umami" flavor, a category of taste in food that comes from the meaty flavor from glutamates and other amino acids. This recipe calls for three types of fermented foods, each adding to the basic foundation for soups and stews eaten throughout Northern Thailand. Fermented shrimp paste



is frequently used in cooking in the lowland areas, while upland communities may rely on fermented soybean paste (dried or wet) to add umami to their foods.

*Grill dried disks of fermented soybean paste about 4-5 inches over a low flame. Whether you are using gas flame or charcoals, turn the disk frequently to evenly roast each side and releasing its full nutty flavor. Allow to cool and crisp up before pounding it into a fine powder.

Substitutions:

- We added fermented fish, shrimp, and soybean flavors to get a well-balanced taste in the soup. You can choose to add only one of the three items – all of this depends on your preference! Should you not be able to find any of these ingredients, you may want to use Japanese miso (fermented soybean paste) instead.
- Fermented shrimp paste can be easily found in local markets. It is known as kapi in Thailand, ngapi in Myanmar, belachan in Malaysia, and terasi in Indonesia. We used the pale-coloured paste that is found in Thai markets for adding umami and salty tastes to soups and curries. If you cannot find it, you can use miso as an alternative.

Tangy Burmese Roselle Leaf and Shrimp Soup

Rosy red roselle juice made from the dried calyces is enjoyed throughout the tropics but the leaves are less well-known for eating as a vegetable. In Burma, however, the lemony-sour green vegetable known as ching baung ywet is prepared as a tasty rice condiment when cooked with onions and turmeric. This soupy version of roselle is a popular way to prepare dried seafood into sour broths eaten throughout the region. The leaves cook down quite a bit and don't be too surprised by how it thickens the texture of the broth!



Preparation time: 15 minutes.

Cooking time: 10 minutes.

Serves: 3-4 people as a side dish, when served with a rice meal.

Ingredients:

- 3 cups of water
- 10 g dried shrimp* (about less than ¼ cup), rinsed with hot water

Pound together with a mortar and pestle or mince finely together:

- 5 fresh chili peppers
- 4 cloves garlic
- 5 whole shallots
- 2-3 cups fresh roselle leaves, removed from stems and washed
- 2-3 tsp salt, to taste

Directions:

1. Make the broth in a medium pot by bringing water to a boil and then add the rinsed dried shrimp. Let the water return to a gentle boil to soften the shrimp and release a warm broth fragrance.
2. Add the chilies and garlic to the broth, stirring everything in gently. Throw in the whole shallots and let them cook through by waiting for them to turn translucent.
3. Once the shallots are cooked, turn off the heat. Add the roselle leaves and stir to submerge them under the broth. The bright green colour will quickly turn to a dull brown as the heat breaks down the pigments in the leaves. Let all the leaves turn to a dull brown before seasoning with salt to taste.
4. Serve as a side dish with a rice meal.

Note: Roselle pairs well with dried seafood or fish that is not smoked.



Tender Young Okra and Baby Eggplant for Dipping with Chili Pastes

Throughout Southeast Asia, okra and eggplants and other vegetables are cooked quickly in boiling water (a cooking method known as "blanching") and eaten with fiery chili pastes. Since the cooking time is relatively short and the vegetables are cooked whole, important nutrients may not be lost. This is a quick and easy way to enjoy these tender vegetables!



Preparation time: less than 5 minutes.

Cooking time: less than 10 minutes.

Serves: 2-4 people as a side dish, when served as part of a complete meal.

Ingredients:

- 10-15 fresh baby eggplants, with stems attached
- 10-15 fresh okra pods

Directions:

1. Bring water to a boil in a large pot. In order to cook the vegetables in a uniform manner, cook the eggplant separate from the okra.

2. Carefully place eggplants into the pot and allow the water to return to a full boil. Small eggplants can be removed from the water after 3-5 minutes. The fruits should be tender to the touch and lose their bright purple color.

3. Bring the water back to a full boil and then add the okra pods. They are fully cooked after 2-3 minutes in boiling water. Eat the vegetables by scooping or dipping in chili pastes. The stems are not edible and can be discarded.

Note: The vegetables will continue cooking after being removed from the boiling water. If you want to stop the cooking process, plunge the okra and eggplant into cold water and allow them to cool fully.

Substitutions:

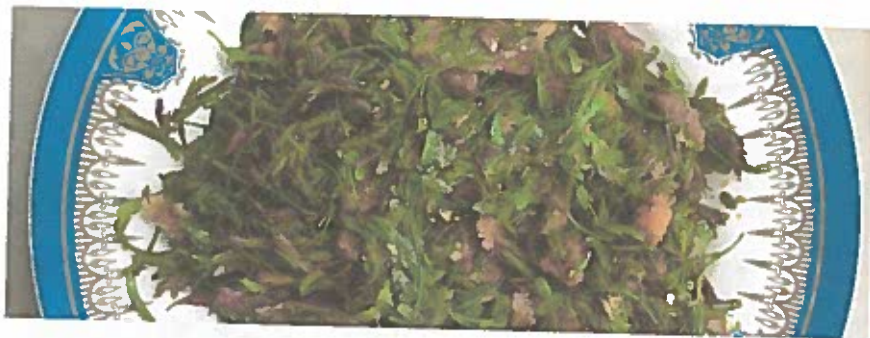
Many of the vegetables presented in the Practical Nutrition Guide can be prepared and served using this method. Some plants require a minimum of 10 minutes of boiling in order to release cyanogenic toxins or to reduce astringent taste from latex contained within the plant – these are starred with an *.

- Shoots, leaves and flowers of –
 - Plants within the Cucurbitaceae family,
 - Acacia/cha-om
 - Cassava*
 - Chaya*
 - Cassod ("khi lek")*
 - Chiang daa*
 - Cluster fig*
 - Katuk
 - Malabar spinach
 - "Sa lae" flower buds
 - Sweet potato
 - Young bitter melon fruits
 - Young pigeon pea seed pods
 - Young rice bean seed pods
 - *Sesbania grandiflora* flowers ("dok khae")
- Young luffa gourd fruits
- Young moringa seed pods
- Young vegetable lablab seed pods
- Young winged bean seed pods
- Leucaena seed pods



Young Tamarind Leaf Salad with Pork Rinds and Golden Garlic

Known for its sweet-tart brown fruit used in sweets and drinks throughout the region, young tamarind leaves and shoots are loved for their subtle tart taste in soups and salads. This recipe reflects regional Thai ingredients with Northern Thai fried pork skin to give a delightful crunch and fermented shrimp pastes found in the central areas as the base for the salad dressing.



Prep time: 15-20 minutes.

Cook time: 10-15 minutes.

Serving: 3-4 people as a side dish when served as part of a complete meal.

Ingredients:

- 4 cups tamarind leaves and shoots, washed
- 2 green firm tomatoes, sliced thinly length-wise
- 3-4 whole small shallots or 1 medium white onion, sliced thinly

Roast together in a dry pan and then pound together with a mortar and pestle*:

- 6-7 dried chili peppers, roasted
- 2-3 small garlic cloves (if possible, avoid using the large Chinese varieties)
- 2-3 small shallots
- 1 tsp fermented shrimp paste
- 1 cup pork rinds*, cut into small pieces
- 1-2 slices lime, for seasoning the dressing
- Fried garlic*

Directions:

1. In a small sauce pan over low heat, make the salad dressing by mixing the fermented shrimp paste with a few spoons of water, making sure that there are no lumps. Add the roasted and pounded mixture of chilies, garlic, and shallots to the saucepan, stirring until smooth.

2. Add a handful of the pork rinds to the sauce, coating all the pieces with the dressing. Add a squeeze of lime juice to the pan, seasoning to taste.

3. In a large bowl, combine the tamarind leaves, tomatoes, and sliced shallots. Pour the sauce over it and mix well so that all the ingredients are coated with the dressing. Garnish with the fried garlic and reserved pork rinds.

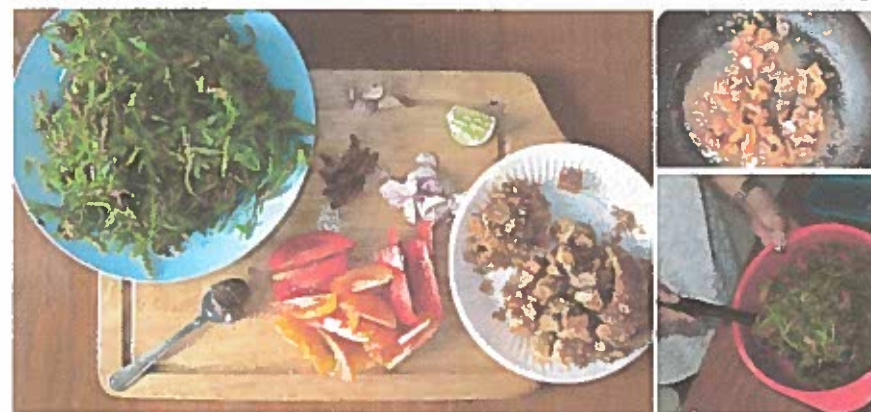
Notes: When roasting the chilies, garlic, and shallots together, be careful not to burn the dried chili peppers. Place a dry pan over low heat and roast the garlic and shallots first, allowing them to turn slightly translucent. Then add the dried chilies and roast until the chilies turn a darker brown along the sides. Alternatively, you can roast each ingredient separately to avoid burning.

Pork rinds can be found easily in the markets of Northern Thailand.

Fried garlic is a lovely garnish to this dish and can be readily found in most Thai markets. However, if you do not have access to it, you can make it at home. Wash whole garlic cloves with the skin on and lightly pound with a mortar and pestle to break up each clove to give a rough texture. The garlic skin should be broken and the cloves coarsely mashed but do not pound until it is a fine paste. Over low heat, pour enough oil to cover the bottom of a small saucepan about ½ inch (1 cm) deep. Add a bit of garlic to the oil – when it starts to sizzle, the oil is hot enough. Add the rest of the garlic and stir frequently to prevent it from sticking. Allow the garlic to turn golden brown and lower the heat if necessary to prevent burning or the garlic will taste really bitter. Remove from oil and allow to cool. The garlic oil can be stored and used for making fried rice, omelets or drizzling over vegetables.

Substitutions:

- 1 cup of unseasoned and cooked minced pork may be substituted for the pork rinds. Cook in a small pan until the meat is not pink and then mix with the dressing.



Case Studies in Southeast Asia

In this section, we present case studies linking agriculture and nutrition throughout Southeast Asia. The approaches range from an evaluation of a multi-country homestead food production program, identification of sustainable livelihoods through participatory wild foods assessment, "train the trainers" activities, and seed exchanges.

Based on evaluation and monitoring reports, conference notes, and peer-reviewed publications, we present each organization's methodology, lessons learned, and best practices arising from their work in each country. Most reports are available online (see References) or by request by emailing the organization.

Case Study 1: Homestead Food Production Program – Integrating the Agriculture and Nutrition Linkages

Organization: Helen Keller International (HKI)

Countries: Bangladesh, Nepal, Cambodia, and Philippines

Program: Homestead Food Production (HFP)

Approach: Addressing primary pathways to impact household nutrition (Figures 11, 12, & 13)

- Increased availability of micronutrient (MN)-rich foods through increased self production of these foods
- Increased income through sales of surplus production
- Increased knowledge and adoption of optimal nutrition practices including consumption of MN-rich foods
- Linkages established with local health services

Objective: Improve nutritional status of vulnerable members of low income households through home production of micronutrient (MN) rich crops and small animals and poultry

- Nutritional focus broadened to include child growth and not only micronutrient deficiencies
- Emphasis on year-round production of local micronutrient rich crops and animal source foods
- Focus on improving local farming practices as much as possible
- Primary target group: women farmers from poorer households

Methodology: (Figure 12)

- HKI partners with government field agents and local NGOs for three year cycle
- Establish Village Model Farms
- Provide inputs: seeds, saplings, chicks
- Provide agricultural training in optimal techniques for crops and raising small animals and fowl

- Make market linkages as needed
- Provide links to health services and nutrition education (behavior change)

Evidence of Household Food Production (HFP) Programs in Asia:

- Food production alone is not enough to improve nutrition
 - Consistent improvements in:
 - Household production of MN-rich foods
 - Household consumption of MN-rich foods
 - Consumption of MN-rich foods among mothers and children
 - Some improvements in:
 - Income (especially under women's control)
 - Women's empowerment (household decision-making)
 - Inconsistent improvements in:
 - Health outcomes
 - Nutritional status outcomes (anaemia, night blindness, etc.)
- Sustainability and cost-effectiveness
 - 95% of households continue to engage with HFP even after program participation is over
 - \$9 US: 3-year rough cost of gardening component for each participating family
 - Cost-benefit analysis of gardening component shows economic rate of return of 160%

Lessons Learned:

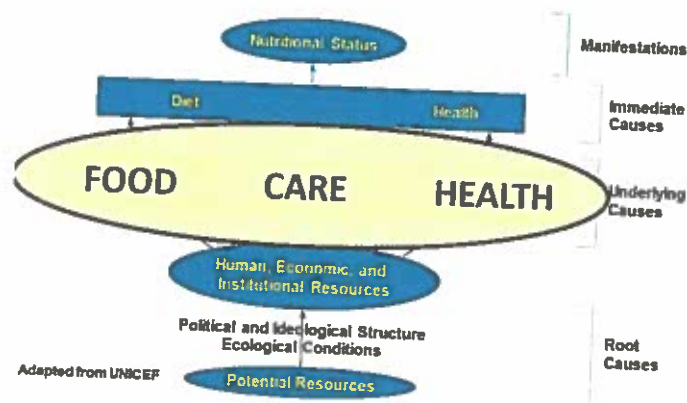
- HFP is highly adaptable
- There is a difference between home gardens = vegetables + fruits versus homestead food production = vegetables + fruits + animal source foods
- Need strong links with local health services
- Need improved focus on essential nutrition actions and behavior change
- Need to continue to pay attention to water and sanitation for nutrition outcomes
- Need to have adequate resources for monitoring and evaluation
- Need to study impact of behavior change on nutritional status, particularly growth
- Use of Program Impact pathways

Conceptual Messages to Take Away:

- Perception that homestead food production is NOT "mainstream agriculture": 860,000 past participants in Bangladesh produced 99,000 metric tonnes of vegetables and 20,000 metric tonnes of fruits over 3 month winter growing season
- Pervasive myth that increased family food production automatically leads to improved nutrition: FOOD + CARE + HEALTH = Nutrition
- Need to leverage agriculture for nutrition: Look at "who" can do "what" along key points of the agricultural cycle (inputs, pre-production, production, harvest, marketing, etc.) (Figure 13)

Lessons learned – program design...

Conceptual Framework of Undernutrition



Adapted from UNICEF

Figure 11: A conceptual framework for understanding underlying causes of under-nutrition (adapted from UNICEF)

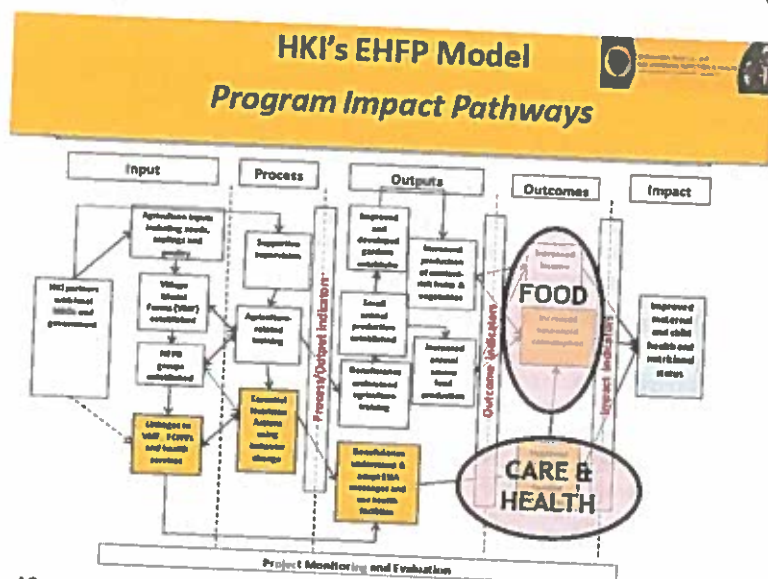


Figure 12: Helen Keller International's areas of impact in their Homestead Food Production model for improving household nutrition outcomes.

The Agriculture Cycle – Nutrition Contact Points



HKI/ISI 2011

Some agricultural actors who 'could' support actions that lead to better nutrition at different contact points in the agricultural cycle:

- Financial services (primarily microcredit)
- Agricultural suppliers (stores)
- Agro-dealers supplying inputs to small-holders such as the public-private ventures supported by AGRA (Alliance for a Green Revolution in Africa),
- Veterinarians including paraprofessionals
- Vendors
- Agricultural extension agents
- Agricultural extension specialists (researchers, academics)
- Farmer networks
- Farmer groups
- NGO field staff
- Commercial companies purchasing from smallholders
- Buyers and traders
- Small-scale millers

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Figure 13: Key agriculture cycle-nutrition contact points identified through Helen Keller International's Homestead Food Production program.

Case Study 2: Train the Trainers Approach – Dietary Diversity and Food Substitutions in Laos

Organization: World Renew

Country: Laos

Area: Hmong and Khamu Ou communities in Udomxai Province; Khamu Ou and Tai-khao communities in Luang Prabang and Phongsaly provinces

Program: Linking agriculture, natural resource management, and nutrition (LANN) program

Approach: Develop practical nutrition capacity of community development trainers to impact upland minority community nutrition.

- Local partners completed training approach
- Participants understood their family nutrition problems in practical terms (self-assessment)
- Participants took appropriate action to address the problems (for example, at the cooking pot, agricultural production, natural resource management, hygiene, mother and child care)

Objective: Improve food security among the poorest by facilitating the development of food and nutritional strategies at the household and community level.

Methodology:

- Coalition of 9 international NGO projects with same village training approach
- Joint approach included implementation and monitoring of activities in spirit of partnership and shared responsibilities
- 3 rounds of 5-day trainings by international consortium, with emphasis on building upon self-assessment findings
- Participatory training activities: food availability calendar; ranking food sources (wild, purchased, own produced); market game for food purchases; hunting/collector game for wild collection
- Visual training toolkit developed (Figure 14)

LANN Promotes:

- The consumption of six food groups per day, and 8-10 glasses (2 litres) of water
- Dietary diversity to increase the chances of getting enough nutrients from a wider selection of foods
 - Vegetables: ferns are rich in beta carotene, mushrooms are rich in iron
 - Starch staples: rice is missing one amino acid that is found in corn
 - Fruit: mango is rich in beta carotene, guava is rich in Vitamin C
- Eating a certain amount of food from a food group to provide enough nutrients
 - Eating 700g of cooked rice will give you enough energy (calories)

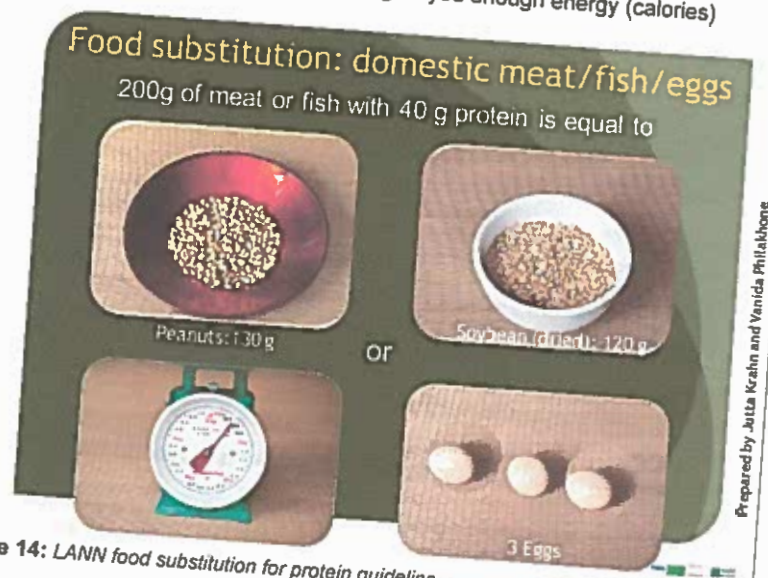


Figure 14: LANN food substitution for protein guideline.

- Eating 200g of fruits will provide you with enough Vitamin C (if fruit intake is diverse and there is adequate intake of vegetables as well)
- Training included visuals of food substitutions and amounts
- Combining food groups for optimal nutrient uptake – pairing food groups:
 - Green leafy vegetables + fat
 - Green leafy vegetables + lemon (or weak acid)
 - Starch staple + beans + seeds
- How to eat six food groups even when there are limited foods available:
 - What to do if no fresh foods available or only leftovers?
 - Be prepared with dried and/or fermented foods
 - Use water from soaking sticky rice and make soup
 - Fry leftover rice with corn or other tubers, add fresh herbs, add peanuts or insects

Strengths of LANN:

- Training staff from different backgrounds of agriculture, health, gender, etc.
- Each international NGO partner can adapt village training tool kit to local context (language, culture) and trainer capacity
- Innovative and effective tools for village roll-out
- Significant lessons learned from joint monitoring and evaluation process
- Cost-effective
- Linking behavior change at cooking pot with food production, natural resource management, and food purchase

LANN opens and encourages dialogue about self production of nutritious plants; managing wild collection of animals and plants; and, informed food purchases at the market; and increased savings

Outputs: training approach and practical toolkit; lessons learned; knowledgeable trainers

Case Study 3: Seed Exchanges and Agroforestry Species - Identifying and Promoting Underutilized Food Plants in Northern Thailand

Organizations: Upland Holistic Development Project (UHDP); ECHO Asia Regional Impact Center (EAIC)

Country: Thailand

Approach: Identifying and promoting underutilized food plants and agroforestry systems and strengthening informal seed systems to impact household nutrition in upland communities

Survey Questions for Determining Background/Baseline Information about Neglected and Underutilized Species:

Questions to consider:

- Should you consider promoting underutilized crops in your focus area?
- Is food security an issue for any specific communities within particular locations or ecosystems in your focus area?
- What are the constraints in accessing food or food-producing crops?
- Are there any environmental factors negatively affecting local food production?
- Are there many alternative crop options available, especially for family food security?
- Are there underutilized crops of potential interest already in your focus area?
- How might you locate them?
- How might you understand their role in local nutrition and in the local economy?
- Are they common among a small population or region but unknown beyond?
- Are they widespread but still considered minor?
- Where can you locate scientific information about these crops?

Market surveys:

- With knowledgeable persons, survey local markets to determine the availability of different types of major crops as well as underutilized crops
- Surveying local foods and ingredients:
 - Talk with families, especially the cooks, to determine what is being consumed locally.
 - Food preferences are difficult, if not impossible, to change. For example, in parts of SE Asia, dairy foods are non-traditional and not likely to be widely accepted. Nor are dried beans widely consumed or particularly welcomed. But new types of leafy greens may gain acceptance fairly readily (although diets are already quite rich in leafy greens).

Farm and garden surveys:

- Local farmers and gardeners will be your most valuable resource in determining which underutilized crops are being grown; and whether any new crops might be useful or welcome. A simple walk and talk through a garden or field will yield a wealth of information.

Seed exchange events:

- Informal seed sharing or organized seed fairs are great ways to both inventory seeds of possible underutilized crops and to access such plant material for promotion among other farmers.

Community-based surveys:

- Avoid misinterpretation in the field. Common flawed assumptions by development workers and "experts" upon entering communities:
 - There are no really viable local crops (otherwise, why is the local population so poor, underfed, etc.?).
 - Local food sources are generally inferior and must be replaced.
 - Locals do not garden ("We saw no vegetables growing around their homes") "All I saw were some bushes". What would be a garden full of edibles to a local person might only appear to be random plants to an outsider.

- Rely on persons with local knowledge to help interpret the information
- Underutilized crop surveys offer an excellent chance to learn not only about local food systems but related development issues (e.g. health and nutrition, sociology, environmental status, seed saving, and seed sharing systems).
- Such efforts honor local farmer knowledge and contribute toward building helpful relationships.

The Learning Arrangement Can Help Lay a Foundation for Future Collaboration for Local Agriculture Development.

- Surveys require significant preparation and cataloging skills as well as essential communication abilities.
- Positive identification of underutilized crops encountered in markets, kitchens, gardens or fields may be a challenge, especially with regard to language obstacles and lack of access to outside resources.
- Farmers may be suspicious of survey activities (perhaps concerned about motives related to bio-piracy, religious proselytization, etc.)

Identifying and promoting non-timber forest product (NTFP) agroforestry systems: Upland Holistic Development Project, Northern Thailand.

- With increasing environmental degradation, hilltribe farmers in Northern Thailand began to cultivate various wild foods, such as snowflake tree, in various home and field settings, that were once naturally common.
- However, seeds and seedlings of other non-timber forest product (NTFP) species, such as rattan, were becoming difficult to locate.
- The Upland Holistic Development Project worked with local communities to catalog dozens of species of interest (i.e. underutilized crops) and determine methods of making the seeds and seedlings of these crops available as well as to develop appropriate agroforest production systems.
- Farmers in several communities began planting agroforest plots containing these underutilized crops for household consumption and sale. Other NGOs have begun visiting these communities to learn and create similar plans for promoting agroforestry.
- Despite the relative abundance of both wild and cultivated vegetables in SE Asia, promoters of chaya, a Central American species, have found ready interest throughout the region. Gardeners already have an affinity for greens and appreciate the perennial vegetables, such as chaya, for being a low maintenance crop

Identifying and promoting underutilized crops: Surveying informal seed systems in Northern Thailand

The objective of the study was to document, within the selected communities:

- Indigenous annual and perennial vegetable crops utilized.
- Seed germination and vigor of seeds of these species.
- How seeds of these crops are produced and shared.

The field research in each of the three communities (eight Thai hilltribe communities and four Khmer communities in Cambodia) consisted of:

- One month of data collection on farmer seed practices.
- Collection and germination testing of farmer-saved seed.
- A seed fair event among the villages involved in that region's research

Key findings from the study included:

- All farmers in the study villages save most of their own vegetable planting seed.
- For the Thai villages, the farmers save nearly all of their own planting seed because many of their primary preferred crops are not commercially available.
- In Cambodia, increased access to commercial varieties in recent years has driven greater reliance on purchased seed.
- In both regions, purchasing planting seed holds higher prestige than saving one's own seeds.
- The most common method of post-harvest seed drying and pest prevention is storage on open baskets over the hearth.

More key findings related to underutilized species:

- During the survey of twelve communities, 48 species of perennial vegetable, and 31 annual species were cataloged.
- Underutilized species are central to local seed systems and play an important role in smallholder farmer livelihoods. Many of these lesser-known species have significant untapped potential for commercialization.
- Much of the robust diversity present within the Northern Thailand food system is due to perennial species used as vegetables.
- Locally important perennial plants often contribute to family nutrition in significant ways, but are sometimes overlooked during inventories of underutilized indigenous vegetables. This is particularly true if the species are foraged from the wild.
- Underutilized perennial species are also important from an ecosystem sustainability perspective.

Related to the seed fairs held in each of the three communities in Thailand and Cambodia:

- Each stimulated informal seed exchange and uncovered patterns of trade and species that were commonly traded.
- The most common varieties of seeds that were brought included various types of cucumber, long bean, eggplant, field beans, okra, winged bean, and vegetable lablab.
- However, a few uncommon varieties showed up as well, including a very large type of lima bean and some grains such as Job's tear, sorghum, and millet.

Case Study 4: Identifying natural resource management and livelihood activities through participatory documentation of wild foods of forest-dependent communities in northern Cambodia

Organizations: Nomads RSI, Cambodia NFTP Working Group (CNWG), Indigenous Peoples for Agriculture Development in Cambodia (IADC), International Cooperation Cambodia (ICC), NFTP-Exchange Program, Food and Agriculture Organization of the United Nations (FAO)

Country: Cambodia

Areas: Kreung ethnic minority communities in Northern Cambodia

Approach: Participatory needs assessment, including analysis of wild food in the food chain and analysis of livelihoods and food security strategies to define strategic activities

Methodology:

- Documenting wild food species diversity and determination of key species
- Analysis of the role of wild foods in the food chain
 - Food and wild food acquisition and supply: who is responsible; where do they get the food; why they choose one type of food over another?
 - Wild food collection techniques: food collection and how knowledge of collection practices is transmitted
 - Food and wild food processing techniques: cooking practices
- Analysis of livelihood strategies regarding food security: how wild food diversity is mitigating impact of land use and climate changes on food security

Lessons Learned:

- Field surveys should take place throughout the year because wild foods collection is a seasonal activity
- Botanical identification should be confirmed by trained botanist and implemented throughout the year to collect all growth phases of plants
- Focus on interviewing women, particularly those identified as being "experts" on food preparation
- Characteristics of key wild foods species:
 - Easily found in areas close to the village and commonly used areas
 - Abundant
 - Can be kept for a long period of time or stored well
 - Can be collected over long periods during the year
 - Height of shrubs or trees allow for fruits to be easily accessed and harvested
 - Can be found in local markets
- Food acquisition:
 - How food is collected (hand vs. machete) impacts plant regeneration and overall sustainability
 - Daily food collection considerations (early AM; no storage – immediate usage)

- Seasonal acquisition considerations (rainy vs. dry season; year-round)
- Mushrooms are collected year-round, depending on species
- "Bases" for food collection: frequent collection from active and fallow fields; not as frequent from deep inside forest as would be expected; fields near streams and ponds
- Gender: Over 55% of women in communities interviewed were responsible for foraging and harvesting wild foods
- Storage considerations (which species can be stored and for how long?)
- Decreased meat supply from forest due to deforestation; traditionally over 70% of meat and fish acquired from forest; 10% from market
- Coping with food shortages: roots and tubers as acceptable substitutions during rice shortages
- Participatory land-use mapping by community to provide linkages between deforestation and food security

Future Recommendations:

- Land-use strategies to impact food security and livelihoods
 - Assessment of current farming systems and identification of model farmers for adaptive agroforestry approaches
- Preventing loss of indigenous food plant and cuisine knowledge
 - Documenting traditional recipes and then adapting into modern recipes for maximizing nutritional output
 - Documenting wild foods preservation and processing methods among various ethnic groups; knowledge exchange events between different ethnic communities
- Awareness of balanced diet and nutrient content of wild foods
- Natural resource management approaches focusing on wild food species
 - Botanical identification and assessment of key wild food species
 - Advocacy on food security issues for forest-dependent communities to local and national authorities
 - Securing community forest or communal land titling with focus on wild vegetable management
 - Sustainable collection techniques of wild food plants
 - Focused investigation on cultivation and management of rapidly disappearing wild food varieties like bamboo, wild yam species, fruit trees, legumes etc. Can these be locally domesticated and propagated for multiplication as informal germplasm preservation? How to sustainably collect species to protect regenerative capacity?

Helpful Resources

AVRDC (The World Vegetable Center)

Excellent global/regional source of information on vegetable production, including indigenous varieties. An international nonprofit research and development institute that is committed to alleviating poverty and malnutrition in the developing world through the increased production and consumption of nutritious and health-promoting vegetables.

Founded in 1971 by the Asian Development Bank, Japan, Korea, Philippines, Thailand, USA, Vietnam, and the Republic of China (Taiwan) with a mandate to work in tropical Asia with its headquarters campus in Taiwan dedicated on 17 October 1973. As the Center gained expertise and capacity, it expanded into sub-Saharan Africa, Central Asia, and South Asia. In 2008, the organization adopted a new name — AVRDC – The World Vegetable Center — to reflect its global scope.

CGIAR – Consultative Group on International Agricultural Research

An international organization which funds and co-ordinates research into agricultural crop breeding with the goal of "reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring more sustainable management of natural resources." CGIAR has a network of 15 research centers, of which those most likely to have some focus on underutilized crops include:

- Bioversity International
- International Center for Agricultural Research in the Dry Areas (ICARDA)
- International Center for Tropical Agriculture
- International Crops Research Institute for the Semi-Arid Tropics
- International Institute of Tropical Agriculture
- World Agroforestry Centre (ICRAF)

ECHO Regional Impact Centers & ECHOcommunity.org

ECHO is a global Christian organization that equips people with agricultural resources and skills to reduce hunger and improve the lives of the poor. ECHOcommunity is a membership community that provides access to nearly all of ECHO's resources online, as well as communications tools to help development workers connect with each other. www.ECHOcommunity.org

FAO – Food and Agriculture Organization of the United Nations

Offers a tremendous wealth of technical resources covering a wide range of food production topics, particularly for the developing world. <http://www.fao.org/home/en/>

Asclepi- daceae	Gynemna indorum	Chiang Dae	อินโพน	No	Avail- able as ECHO cuttings	Perennial	Vine	Shoots and leaves - year- round, flavor of hot season considered the best	Fields and forests	Chiang dae (the common Thai name) is a perennial vine that can be found in disturbed areas throughout Southeast Asia. According to Chiangmai University researchers, chiang dae has high antioxidant activity and high levels of Vitamin E.
Athyri- aceae	Diplazum eculanum	Vegetable Fern	อินญา	No	Avail- able as ECHO cuttings	Perennial	Herb	Best during rainy season - Usually found along stream banks in shaded forests	Forests	Vegetable fern is indigenous to East and SE Asia and is probably the most important edible fern in the world. It is mainly found along river banks, open places in wet ground, or in the understory of moist forests at elevations below 800 meters. It is easily grown in home gardens, moist agroforestry settings, and may be planted densely in understory beds with heavy shade (Burnette et al. In Press, HEAR org 2012)
Basella- ceae	Basella alba	Malabar Spinach	อินโผล่	Yes	Yes	Perennial	Vine	Year-round if there is adequate rain or irrigation	Gardens	Malabar spinach is a perennial (or semi-perennial) herb grown for its tender stems and leaves, which can be cooked like spinach. It is grown widely in the tropics as a perennial and in warmer temperate regions as an annual. It is easy to grow and does well in a variety of soils, but prefers humus-rich, well-drained soils with a pH range of 5.5-7.0 (ECHO Asia Seed Fact Sheet)
Bignoni- aceae	Crorylam indorum	Indian Trumpet	อิน (central/su- th/northern)	No	Avail- able as UHDP seeds	Perennial	Tree	Rainy season	Fields and forests	Indian trumpet is a small tree that prefers well-drained, sunny locations, making it ideal for establishing mixed plantings of mammal-shading. It can be food-producing plants in agroforestry or home gardening settings. It can be a pioneer species in a newly planted agroforest setting or even used along with pineapple, lemon grass, and tea as soil-conserving counter hedges (UHDP 2006, Burnette et al. In Press)
Convol- vulaceae	Ipomoea batatas	Sweet Potato	อินทผา	Yes	Avail- able as ECHO cuttings	Perennial	Vine	Shoots and leaves - year- round; tuber - year-round	Gardens	Originally from South or Central America, sweet potato is now the 6th or 7th most produced food crop in the world. It is high in nutrients, has a relatively high productivity, and has the ability to thrive on a variety of soils, but moist, well-drained organic soils produce the best results. It is a tropical and subtropical plant which can adapt to more temperate climates if the average temperature does not drop below 20°C (68°F) and minimum temperatures stay above 15°C (59°F). It can be grown up to 2500m and requires full-sunlight for best yields (TN Sweet Potato 1998).
Cucurbi- taceae	Momord- ica charantia	Bitter Melon	อินทผา (variety in ECHO 58)	Yes	Yes	Annual	Vine	Shoots and leaves - year- round; fruit - hot season	Gardens and fields	Bitter melon is an annual vine that prefers well-drained, sandy loam soil but will grow in areas with poorer soils. It produces edible tender vine tips that are rich in vitamin C and calcium and immature fruits that have toxic acid and vitamin C (ECHO Asia Seed Fact Sheet)
Cucurbi- taceae	Lagenaria siceraria	Cala- bash, Bottle Gourd	อินโกล	Yes	Yes	Annual	Vine	Shoots, leaves and fruit - rainy and cold seasons	Gardens and fields, grown along edges of wadden fields	Bottle gourd is a vining annual that grows up to 30 feet in length and is grown throughout Asia for its edible shoots, leaves and fruit. It is generally best-suited for semi-dry areas but is found throughout sub-tropical and tropical environments and grows best in well-drained, loose soil with a good layer of compost (ECHO Asia Seed Fact Sheet)

Cucurbi- taceae	Cucurbita maxima	Cucum- ber	อินโกล	Yes	Yes	Annual	Vine	Fruit - year round if there is adequate rain or irrigation	Gardens and fields	The cucumber is an annual herbaceous plant trailing or climbing from 1.5 - 4.5 m (5 to 15 ft) by means of simple tendrils. Cucumbers are not suited to high mountain climates or very dry seasons. Daytime temperatures of no lower than 18°C (65°F), humidity of 80-90%, and rainfall of 100-200 mm (4-8 in.) per month produce the best results, especially when grown in loose, well-drained soils amended with organic matter (ECHO Asia Seed Fact Sheet)
Cucurbi- taceae	Coccinia grandis	Lily Gourd	อินโกล (central/su- th/northern)	Yes	No	Perennial	Vine	Shoot and leaves - cold and rainy seasons	Gardens and fields	Lily gourd is a perennial vine with white, star shaped flowers and cucumber-like fruit which is green when immature and bright red when ripe. It tolerates a wide-range of habitats and can be found up to 2050 m (7700 ft) altitude. In countries where Lily Gourd has been introduced, it can become a serious weed because it grows fast, covering the ground and smothering shrubs (ECHO Asia Seed Fact Sheet)
Cucurbi- taceae	Cucurbita maxima	Pumpkin	อินโกล	Yes	Not yet	Annual	Vine	Shoots, leaves, young fruits - rainy season; older fruits - cold season	Gardens and fields	Pumpkin is a vining annual that originated in North America, possibly Mexico, and is now widely distributed throughout the tropics. The vines will grow widely along the surface of the ground, rooting at nodes, or they may be grown on trellises or other supports. Pumpkins thrive in warm conditions and pumpkin vines need fertile, compost-rich, well-drained soil in full sun. (ECHO Florida Seed Fact Sheet). The maxima species contain varieties that have pumpkin-like fruit but the skin is usually more yellow than orange and the stems are soft and spongy or corky (HortAnswers 2015)
Cucurbi- taceae	Cucurbita moschata	Pumpkin/ Squash	อินโกล	Yes	Not yet	Annual	Vine	Shoots, leaves, young fruits - rainy season; older fruits - cold season	Gardens and fields	Pumpkin is a vining annual that originated in North America, possibly Mexico, and is now widely distributed throughout the tropics. The vines will grow widely along the surface of the ground, rooting at nodes, or they may be grown on trellises or other supports. Pumpkins thrive in warm conditions and pumpkin vines need fertile, compost-rich, well-drained soil in full sun. (ECHO Florida Seed Fact Sheet). The moschata species contain varieties that produce long and oblong fruits with tan skin (HortAnswers 2015)
Cucurbi- taceae	Luffa cylindrica	Smooth Luffa Gourd	อินโกล	Yes	Yes	Annual	Vine	Shoots and leaves - year- round; gourd one month after planting	Gardens and fields	Luffa is a climbing annual that when mature, produces oblong fruit about 1 foot long that are full of fiber and oval, black seeds. Luffa generally grows well wherever cucumbers thrive but prefers well-drained, fertile soil (ECHO Asia Seed Fact Sheet)
Cucurbi- taceae	Tichocarpus cucurbitaria	Snake Gourd	อินโกล	Yes	No	Annual	Vine	Shoots, leaves and fruit - cold and rainy seasons	Gardens and fields	Snake gourd is indigenous to South and Southeast Asia, and has a habit very much like cucumber or pumpkin. It is best grown on a trellis for supporting the snake-like fruits and providing ample amounts of sunlight. It can be grown in the tropics and sub-tropics at elevations up to 1,500 metres, and it grows best in areas where annual daytime temperatures are within the range 22 - 32°C, but can tolerate 14 - 35°C. It prefers a mean annual rainfall in the range 2,000 - 2,500mm, but tolerates 700 - 4,200mm and it grows best in a rich well-drained soil with plenty of moisture in the growing season (HEAR org 2012)

Cucurbitaceae	Berliniaceae Trapezoid	Vine Cantaloupe, Watermelon	Shrub	Yes	Yes	Annual	Vine	Shoots, leaves and fruit - cold season, fruits have long duration for storage	Gardens and fields	Vine gourd is an annual squash-like vine, with large, soft, hairy leaves and fruits that are large, oblong, 25-120 cm long, hairy when young, but with a very covering when ripe. It requires a growing season of 4-6 months, and in Thailand, is usually planted near the beginning of the rainy season when rice is planted. It is best suited to moderately dry areas in the tropics with an optimum temperature for growth ranging from 23-28°C and prefers a well-drained light soil with pH 6.0-7.0 (ECHO Asia Seed Fact Sheet).
Euphorbiaceae	Moringaceae	Cassava	Shrub	Yes	No	Perennial	Shrub	Year-round as long as there is adequate rain or irrigation, leaves drop during drought	Gardens and fields	One of agriculture's oldest crops, cassava is native to South America and is primarily grown as a perennial orchard and field crop species. Attaining heights of 1-5 meters, it is propagated from stem cuttings and is tolerant of acid soils, making it a well-suited crop for smallholder farmers of the tropics (FAO 2013).
Euphorbiaceae	Celastraceae	Chaya, Tree Spinach	Shrub	Yes	Available as ECHO cuttings	Perennial	Shrub	Year-round generally; tolerates drought and flooding, best during cold season as more aphids present during rainy season	Gardens	Chaya is a fast-growing perennial shrub native to Mexico that produces lots of attractive, large, dark green leaves. It can grow well on a wide range of soils in both hot, rainy climates and areas with occasional drought. It grows easily and quickly, especially at higher temperatures, and new leaves grow quickly after harvesting (TN Chaya 2006).
Euphorbiaceae (Phyllanthaceae)	Saururus androgynus	Kabuk/Sweet Leaf	Shrub	No	Available as UHDP cuttings	Perennial	Shrub	Year-round as long as there is adequate rain or irrigation, leaves drop during drought	Fields and forests	Kabuk is indigenous to SE Asia and very often found planted in home vegetable gardens, where it can adapt well to varying amounts of shade. The shoots of kabuk are produced throughout much of the year, particularly with the availability of moisture. One productive bush can offer several edible shoots at a time, making it a very good perennial food source with very little effort involved (UHDP 2006, Burnette et al. In Press).
Fabaceae	Acacia pennata	Acacia (Cha-om)	Shrub	No	No	Perennial	Shrub	Year-round but favour toward-end best during dry season	Gardens and fields	Acacia is an indigenous forest species native to SE Asia which grows well in an agroforestry setting with various amounts of shade. It tolerates many different growing conditions, and the small tree handles coppicing well to produce more young shoots and leaves. (UHDP 2-4).
Fabaceae	Sesbania	Cassia Tree	Tree	No	Yes	Perennial	Tree	Flowers and shoots best collected during rainy season (at the start)	Gardens and fields	Cassia is an indigenous forest species native to SE Asia which grows well in an agroforestry setting with various amounts of shade. It tolerates many different growing conditions, and the small-medium sized tree grows very quickly, making it well-suited as a nurse species for shade-loving trees and as a fuelwood source in addition to its edible qualities (UHDP 2006).

Fabaceae	Leucaena diversifolia/Leucaena leucocephala	Ipil Ipil	Shrub	No	Yes	Perennial	Tree	Year-round	Gardens and fields	Leucaena diversifolia is a multi-purpose 3-20 m tall tree species originally found in Central America but has become naturalized throughout many parts of the world. In the tropics, Leucaena diversifolia grows in areas from 700-2500 m altitude and is found in cool and seasonally wet locations with an average annual rainfall of 800-2800 mm and a mean maximum temperature in the hottest month of 18-30°C. In addition to its culinary uses, it can also be used for fixing nitrogen for soil improvement, reforestation projects, livestock fodder, as a windbreak or contour hedgerow plant in such applications such as SALT, and as a paper or fuelwood (ECHO Asia Seed Fact Sheet).
Fabaceae	Vigna radiata	Mung Bean	Shrub	No	Yes	Annual	Vine	Collect pods at end of cold season	Gardens and fields	A bushy or very annual tree that produces yellow flowers and pods up to 15 cm (6 in.) in length. Mung bean is an important grain legume crop throughout Asia for its use as food, an intercrop with rice, and as a green manure and fodder. It grows mainly within 20-40°C (68-104°F) and up to altitudes of 2000 m (6562 ft.) in the tropics. Easy to grow in a wide range of soil types, it prefers well-drained loams or sandy loams with a soil pH range of 6.2-7.2 (ECHO Asia Seed Fact Sheet).
Fabaceae	Cajanus cajan	Pigeon Pea	Shrub	No	Yes	Perennial	Shrub	Cold season	Gardens and fields	Pigeon pea is a perennial, tree-like shrub that grows to 1.2 - 3.1 m (4.10 ft.) tall and is used for food and fodder as well as in agroforestry systems. Originally from India, but now grown throughout the tropics, it produces dark green leaves and green, edible pods with seeds that are high in protein. Generally considered drought-resistant, pigeon pea can be grown on a wide range of soil types, and optimum average temperatures range from 18-29°C where annual rainfall ranges from 500-1,200 mm (20-50 in.) a year (ECHO Asia Seed Fact Sheet).
Fabaceae	Vigna umbellata	Rice Bean	Shrub	No	Yes	Annual	Vine	Collect pods at end of cold season	Gardens and fields	Rice bean is a twining annual with yellow flowers and edible beans that can also be grown as a semi-perennial. There are both climbing and bush types of rice bean, and it is commonly grown for food, as fodder, and intercropped with rice, corn, sorghum and cowpeas in the upland tropics. Rice bean is adapted to regions with 1,000-1,500 mm (40-60 in.) precipitation, is tolerant to high temperatures and high humidity, and can tolerate diverse soil conditions (ECHO Asia Seed Fact Sheet).
Fabaceae	Sesbania grandiflora	Sesbania	Shrub	No	Yes	Perennial	Tree	Flower best collected between cold and hot seasons	Gardens and fields	Sesbania is a small, quick-growing, bushy-branching tree with compound, alternate leaves. It is well-adapted to hot, humid environments and does not grow well in the subtropics with cool temperatures below 10°C (50°F). It is tolerant of a high variety of soil types, including heavy and very poor soils, and useful as a nitrogen fixing plant for soil improvement, high-quality livestock fodder, as a hedgerow or windbreak, and for pulp and paper production (ECHO Asia Seed Fact Sheet).
Fabaceae	Acacia cordata	Shikakai, Soap Pod Acacia	Shrub	No	No	Perennial	Tree	Shoots and leaves - year round	Gardens, fields, forests	Soap Pod is a quick-growing, climbing shrub native to Asia. It is a nitrogen-fixing tree when the correct bacteria are present in the soil and is adaptable to many different types of habitats (Useful Tropical Plants Database).

Febeceae	<i>Canavalia gladiata</i>	Sword Bean	ข้าวสาร	No	Yes	Semi-annual	Vine	Pods - cold season	Gardens and fields	Sword bean is known chiefly as a cultivated species and may have been derived from a wild species occurring principally in Africa, but is now found throughout South and Southeast Asia. It thrives in tropical climates exhibiting moderately high temperatures (15-30°C/59-86°F). Preferred environmental conditions are found in the humid lowlands, but these beans may be grown with success in elevations to 1000 m (3000 ft), and are well-adapted to growth and survival in low-quality soils (ECHO Asia Seed Fact Sheet).
Febeceae	<i>Tamarindus indica</i>	Tamarind	มะขาม	No	No	Perennial	Tree	Shoots and flowers - best collected in hot season, young fruits - end of hot season and start of rainy season, older fruits - cold season	Gardens, fields, forests	Tamarind (<i>Tamarindus indica</i>) is a tree that grows throughout the tropics and is valued in northern Thailand, as elsewhere, for its pulpy pods, tender leaf shoots, and flowers, which are used in a variety of dishes. The tree can be found in backyard gardens, in orchard settings, as well as in hill fields. It is well-adapted to semi-arid tropical conditions, although it does well in many humid tropical areas of the world with seasonally high rainfall and grows well in deep, well-drained soils that are slightly acid (ECHO Florida Seed Fact Sheet).
Febeceae	<i>Lathyrus purpureus</i>	Vegetable Lablab Bean	ถั่วลิสง	No	Yes	Semi-annual	Vine	Cold season	Gardens and fields	Vegetable lablab is a climbing, perennial (or semi-perennial) legume commonly grown in gardens for edible purple pods, the use of manure, irrigation, and supports in home gardens will improve productivity. It is remarkably adaptable, growing in various climates and regions with annual rainfall ranging from 200 to 2,500 mm (8-98 in) and elevations ranging from sea level to 2,133 m (7,000 ft). As a nitrogen fixer, it can grow in many types of soils with a pH varying from 4.4 to 7.8 (ECHO Asia Seed Fact Sheet).
Febeceae	<i>Passiflora ligularis</i>	Winged Bean	ถั่วปีก	No	Yes	Semi-annual	Vine	Shoots, leaves and fruits - cold season	Gardens and fields	Winged bean is a climbing perennial with large pale-blue flowers that produce 15-20 cm (6-8 in.) winged pods at maturity and is widely distributed through the tropics and subtropics. Planted at the beginning of the rainy season, it grows in the tropics at elevations up to 2100 m (6,890 ft). It thrives in hot, wet climates, although a dry period is favorable for fertilization and the production of mature pods. It will grow under a variety of soil conditions except in sand or high salinity (ECHO Asia Seed Fact Sheet).
Febeceae	<i>Vigna unguiculata</i> ssp. <i>Sesquipedalis</i>	Yardlong Bean	ถั่วฝักยาว	Yes	Yes	Annual	Vine	Pods - cold season	Gardens and fields	Yard long bean most likely originated in southern China and is a legume closely related to the common cowpea, which is typically cultivated for its edible immature pods between 30 and 50 cm in length. It thrives in hot humid climates, preferably with full sunlight, with daytime temperatures of 20-35°C, and may begin fruit production as early as 7 weeks after planting. It will tolerate acidic and relatively poor soils and low-moisture environments, but prefers deep, fertile, well-drained loam and will benefit from trellising.
Melastomaceae	<i>Abelmoschus esculentus</i>	Okra	มะเขือยาว	Yes	Yes	Annual	Shrub	Continuous harvesting optimal	Gardens and fields	Okra is an upright annual about 1 to 2 m (3 to 6 ft) tall with a main stem and several branches. It is a prolific producer of dark green pods that can be harvested continuously for weeks. It needs full sunlight on fertile, well-drained soils, in hot climatic conditions (ECHO Asia Seed Fact Sheet).

Melastomaceae	<i>Hibiscus sabdariffa</i>	Rosehip	มะเขือ/มะเขือเทศ	Yes	Yes	Perennial	Shrub	Year-round, leaves best collected during rainy season, calyx best harvested during cold season	Gardens and fields	Rosehip is a tall, slightly bushy perennial plant with red stems, leaves and succulent calyxes. It is suitable for tropical climates with well-distributed rainfall of 1500-2000 mm yearly, from sea-level to about 500 m altitude, and can adapt to a wide-range of soil types. One thing to note is that Rosehip is a short-day plant, it will not flower when days are over 13 hours (ECHO Asia Seed Fact Sheet).
Moraceae	<i>Ficus racemosa</i>	Cluster Fig	ทุเรียน (Central/Thailand) (northern?)	Yes	No	Perennial	Tree	Best collected during hot and dry season for best flavour	Fields and forests	Cluster fig is an indigenous forest species native to SE Asia which grows well in an agroforestry setting with various amounts of shade. It tolerates many different growing conditions, and the medium-large sized tree produces new shoots and leaves during the dry season when very few other edible plants may be productive. It has traditionally been used mainly for household-level consumption in N. Thailand (UHPD 2008, Burnette et al. In Press).
Moraceae	<i>Ficus virens</i>	Fig Leaf, Red or White	ทุเรียน (northern/Thailand) (central)	Yes	No	Perennial	Tree	Best collected during hot and dry season for best flavour	Fields and forests	Red or white fig is an indigenous forest species native to SE Asia which grows well in an agroforestry, home garden, or mixed orchard setting with various amounts of shade. It tolerates many different growing conditions, but grows best in moist tropical lowlands, and the medium sized tree produces new shoots and leaves during the dry season when very few other edible plants may be productive. It has traditionally been used mainly for household-level consumption in N. Thailand (UHPD 2008, Burnette et al. In Press).
Moraceae	<i>Morinda citrifolia</i>	Morinda	มะขาม	No	Yes	Perennial	Tree	Year-round as long as there is adequate rain or irrigation, leaves drop during drought	Gardens and fields	The morinda tree is a drought resistant, fast growing, deciduous tree or shrub with an average height of 12 meters (39 ft) at maturity. Very easy to grow in many parts of the world, Morinda grows best between 25 to 35°C (77-95°F), but will tolerate up to 40°C (104°F) in the shade and can survive a light frost, however, it will not survive prolonged flooding or poorly-drained soil. Besides its human nutrition, Morinda can be used for living hedges, fences, and windbreaks, as paper pulp, as an animal fodder or nutritional supplement for livestock, and its seeds for water purification (ECHO Asia Seed Fact Sheet).
Musaceae	<i>Musa sapientum</i>	Banana	กล้วย	No	No	Perennial	Herb	Year-round from gardens, fields and forests	Gardens, fields, forests	Banana is a versatile plant, with surprisingly edible hearts of the stem and flower blossoms, after removing its outer layers. Like leaves of ginger plants, banana leaves are commonly used for wrapping flavour if wrapped food are grilled.
Piperaceae	<i>Piper nigrum</i>	Leaf Pepper	พริก (central)	No	Available as UHPD cuttings	Perennial	Vine	Year-round from the forest	Forests	A space efficient vine, leaf pepper can grow quickly under heavy shade, utilizing other trees for support. Grows well in an agroforestry or home garden setting. This non-woody perennial is indigenous to the forests of Thailand, and is valued as both a food source and an ornamental ground cover. (UHPD 2008, Burnette et al. In Press)

Neglected and Underutilized Species: Plant Consumption Glossary

Family	Scientific Name	Common Name	Thai Common Name	Edible Part and Taste	Cleaning and Preparation notes	Cooking Notes	Nutritional Benefits	Anti-nutritive Effects
Amaranthaceae	<i>Amaranthus tricolor</i>	Vegetable Amaranth	อะม่าน	Leaves taste and have similar texture like spinach.	Choose young, tender shoots and tips.	The leaves are added as a vegetable to soups and stir-fried dishes or eaten raw as a salad.	Leaves are high in calcium and iron.	Leaves contain low levels of oxalates.
Arecaceae	<i>Colocasia esculenta</i>	Taro	มัน/ดงมัน	The corm is a mild-tasting starch staple that takes on flavour of seasonings. The stem is generally mild-tasting as well.	Chewy fibres can be peeled off from outer layer of young stems.	The young stem is added as a vegetable to soups or eaten raw as a dipping vegetable. Old stems are not palatable. The corm is a starch staple substitute when boiled, roasted or boiled in soups.	The starch is easily digestible as grains are small. The leaves are a good source of vitamin A and C.	Leaves and stem contain oxalic acid - need to boil and discard boiling water.
Araliaceae	<i>Traveller palm</i>	Sno Flute Tree	ต้นหวาย	Shoots and flowers are bitter-tasting.	Shoots and flowers should be blanched before eating.	The shoots and young flowers are blanched and eaten as a dipping vegetable with chili pastes, or added as a vegetable to soups and curries.		
Arecaceae (Palms)	<i>Caryota nipa</i>	Fishtail Palm	ต้นตาล	Hearts of shoot are tender and sweet-tasting.	Wear gloves when harvesting fishtail palm to prevent skin irritations. Outer sheath protecting tender inner core must be removed in order to prepare shoot for eating.	Fishtail palm heart of shoots can be blanched or grilled and eaten as a dipping vegetable or added as a vegetable to soups and stews.		
Arecaceae (Palms)	<i>Calamus siamensis</i>	Rattan, White Thorn	หวาย	Hearts of shoot are bitter.	Overlapping, spiky, tubular green leaf sheath protecting inner core of young shoot must be removed before preparing for eating.	Rattan heart of shoots can be blanched or grilled and eaten as a dipping vegetable, added to soups and stews as a vegetable or grilled and pounded into chili pastes.		
Asclepiadaceae	<i>Gynostemma inodorum</i>	Cheng Dee	ต้นชั่งดี	The edible shoots and leaves have a nutty, spinach-like taste. It may be considered an acquired taste.	Shoots, leaves and stems can be blanched before consuming. Choose young, tender shoots and tips with small leaves for eating.	Cheng dee is generally eaten as a dipping vegetable in northern Thailand. Choose young shoots with immature leaves.		
Antennariaceae	<i>Diplazium esculentum</i>	Vegetable Fern	ต้นผักแว่น	Shoots and tender stems have a slightly nutty flavour and a tender-crisp texture when blanched.	Eat in moderation. Shoots and stems are usually blanched before they are eaten.	Ferns can be blanched and eaten as a dipping vegetable with chili pastes or in salads, or added as a vegetable in stir-fried dishes. The tender stems snap off in a similar fashion as asparagus.	Rich in beta-carotene, folic acid, and minerals such as calcium, iron and phosphorus.	Contains phytates and tannins; can exacerbate gout if eaten in excess.

Boraginaceae	<i>Basella alba</i>	Malabar Spinach	ผักบุ้ง	The young leaves are mucilaginous and mild-tasting.	Choose small, tender leaves and shoots and tips.	Young and mature leaves can be eaten raw as a salad and as a vegetable in soups and stir-fried dishes. Use lime juice to reduce the mucilage.	Leaves are good source of vitamins A and C, calcium and iron.	
Bignoniaceae	<i>Crozytum indicum</i>	Indian Trumpet	พริก (เขตร้อน/ใต้)	The young dark green pods can be harvested and stored in a cool, dry place for up to 4 days. The bitter flavour can be reduced by soaking in water overnight or less. The pods have a tender crisp texture when cooked.	Edible young pods are firm and flexible, while the older pods are dark-brown to black in colour and no longer edible. Sliced pods can be washed overnight or for a shorter length of time, depending on preference for bitterness. The longer the soaking time, the less bitter it will taste. Place sliced pods in a bowl, add enough boiling water to cover and add 1-2 teaspoons of salt. Discard the water the next day and use the pods in stir-fried dishes.	For stir-fried dishes, slice the pods cross-wise into 1/4 inch thick pieces and soak in water. If eating as a dipping vegetable, whole pods can be roasted over glowing coals until the skin is charred. Remove the skin, slice into pieces and eat with chili pastes. The sliced pods can also be pickled in brine and stored.	Research shows anti-oxidant and anti-inflammatory effects of roots, bark and seeds but unclear about specific nutrients found in young seed pods.	
Convolvulaceae	<i>Ipomoea batatas</i>	Sweet Potato	มันหวาน	Shoots and leaves taste similar to morning glory leaves. The versatile orange tuber is sweet-tasting.	Choose young, tender shoots and tips.	The shoots and leaves can be added as a vegetable in stir-fried dishes or soups. The orange tuber can be roasted, boiled, fried or mashed.	Leaves are rich in protein.	
Cucurbitaceae	<i>Momordica charantia</i>	Bitter Melon	มะขาม	Shoots are edible year-round while the immature fruits are best harvested during hot season for consumption.	Once sliced, the fruits may be soaked in salted water for 15 minutes in order to reduce bitterness. If less bitterness is preferred, soak for a longer period of time.	Shoots and fruits are eaten as a vegetable in soups. Bitter melon stuffed with minced pork and added to pork bone broth is a classic Thai dish. Salads with onions and add to omelette for a quick and tasty meal.	Fruits are high in folic acid and vitamin C; leaves are rich in vitamin A and calcium.	
Cucurbitaceae	<i>Lagenaria siceraria</i>	Cala-bath, Bottle Gourd	แตงโม	Bottle gourd shoots, leaves and young fruit are mild-tasting vegetables.	Choose young, tender shoots and tips that snap off naturally from the stem. The skin of young fruits can be eaten, while skin of older fruits should be removed.	Shoots, leaves and fruits are eaten as a vegetable in soups, curries and stir-fries. They can be easily added to dishes that have stronger-tasting vegetables. Shoots and leaves of the Cucurbitaceae family can be easily stir-fried or steamed with garlic, oyster sauce and fermented soybeans for a tasty vegetable side dish.	Fruits have calcium, potassium and vitamin C. Generally low in sodium and carbohydrates.	

Fe	Cucurbitaceae	Cucumis sativus	Cucumber	သက်တံ / သက်တံ	Shoots and leaves, young and mature fruit (depending on variety).	Peel skin off cucumber fruit.	The shoots and leaves can be eaten as a vegetable in soups and stir-fried dishes. The fruit is usually peeled and eaten raw with dipping sauce or cooked as a vegetable in soups, curries and stir-fried dishes.	Skin and seeds contain beta-carotene, minerals and calcium.	
	An Cucurbitaceae	Cucumis grandis	Hy Gourd	သက်တံ (တောင်) / သက်တံ (တောင်)	The shoots and leaves may be slightly bitter.	Shoots and leaves can be blanched before eating.	The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes.	Contains beta-carotene.	
	Cucurbitaceae	Cucurbita maxima	Pumpkin	သက်တံ	The shoots and leaves are sweet and tender, and the mature gourd fruit is sweet.	Indigestible fibre from stems of shoots can be peeled off before eating. Depending on preference and pumpkin variety, the skin may be kept on and eaten.	The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The gourd fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs. The seeds are roasted and eaten as a snack, or pressed for oil.	Orange gourd fruit is high in Vitamin A. Leaves contain iron, protein, calcium, and vitamins A and C.	
	Cucurbitaceae	Cucurbita moschata	Pumpkin / Squash	သက်တံ	The shoots and leaves are sweet and tender, and the mature gourd fruit is sweet.	Depending on preference and pumpkin variety, skin of fruit can be eaten after cooking. The indigestible fibre from stems of shoots can be peeled off before cooking.	The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The gourd fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs. The seeds are roasted and eaten as a snack, or pressed for oil.	Orange gourd fruit is high in Vitamin A. Leaves contain iron, protein, calcium, and vitamins A and C.	
	Cucurbitaceae	Luffa cylindrica	Smooth Luffa Gourd	သက်တံ	The shoots and leaves are sweet and tender, and the young fruit is mild-tasting.	Choose young, tender shoots and tips, skin of young fruits can be eaten, while skin of older fruits should be removed.	The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The peeled fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs.	Leaves have been used in traditional treatments for anaemia and the seeds have laxative properties.	
	Cucurbitaceae	Tichocarpus cucurbitaria	Sneke Gourd	သက်တံ	The shoots and leaves are sweet and tender, and the young fruit is mild-tasting.	Choose young, tender shoots and tips, skin of young fruits can be eaten, while skin of older fruits should be removed.	The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The peeled fruit can be eaten as a vegetable in soups and curries, or stir-fried with eggs.		
	Cucurbitaceae	Berenicea hispida	Wine Gourd, Winter Melon	သက်တံ	The shoots and leaves are sweet and tender, and the young and mature fruit is mild-tasting.	Skin of young fruits can be eaten, while older fruits should be peeled.	The shoots and leaves are eaten as a vegetable in soups and in stir-fried dishes. The peeled fruit can be eaten as a vegetable in soups and curries. It can also be sweetened and consumed as a drink.	Contains Vitamin C and minerals.	

Euphorbiaceae	Mentholaceae	Celastraceae	Simulaneae	Celastraceae tubers are primarily eaten for calories and are otherwise considerably deficient in nutrition. There is high protein content in young leaves but amino acid content is unbalanced especially methionine. Good quantities of Vitamin B, phosphorus and iron. Cooked cassava leaves have a mild spinach flavour.	Choose young, tender shoots and tips that snap off naturally from the stem. The skin of all tubers should be removed before cooking. Greens need to be blanched at least 10 minutes to release toxic cyanogenic compounds and the cooking water thrown out.	Cassava greens are eaten as a dipping vegetable in the Padang culture in Indonesia. After blanching, the greens can be cooked with shallots, galangal and coconut milk for a sweet-sour spicy dish. Cassava tubers can be boiled, steamed, fried or fermented and prepared into a flour. Brazilian food showcases breads and porridges made from cassava flour.	Tuber primarily eaten for calories, otherwise considerably deficient in nutrition, high protein content in young leaves but amino acid content is unbalanced esp. methionine. Good quantities of Vitamin B, phosphorus and iron. Leaves contain cyanogens that release harmful hydrogen cyanide gas.	
Euphorbiaceae	Chrysanthemaceae	Chrysanthemum	Spinach	Chrysanthemum has sweet-tasting leaves and shoots, and crunchy stems that are similar to broccoli stems in texture. Its leaves are rich in protein, calcium, iron, carotene, riboflavin, niacin and ascorbic acid.	Shoots, leaves and stems should be boiled for at least 10-15 minutes to release cyanogenic compounds. The cooking water should be thrown away. Chrysanthemum leaves and stems will turn a darker green once they are cooked. It is difficult to over-cook as the stems keep its appetizing crunchiness and the leaves remain chewy.	Chrysanthemum is a versatile food plant that can be eaten as a dipping vegetable with chili paste, added as a vegetable in stir-fries and curries. The chewy texture of its leaves is similar to spinach, common lily and papaya leaves.	Leaves are rich in protein, calcium, iron, carotene, riboflavin, niacin and ascorbic acid.	Leaves contain cyanogens that release harmful hydrogen cyanide gas.
Euphorbiaceae (Phyllanthaceae)	Saururus	Katuk / Sweet Leaf	Simulaneae	The shoots and leaves are nutty tasting with a chewier texture than other greens.	Eat raw leaves in moderation. Leaves and shoots should be harvested from the tips of the plant.	The leaves are eaten raw in salads, or added to soups and stews as a vegetable. The juice from leaves can be extracted.	High protein content in leaves (5-10%), rich in carotenoids.	Alkaloids, accumulate in body if excessive amounts of raw leaves and juice consumed and can lead to diarrhoea and constipation among other effects.
Fabaceae	Acacia	Acacia (Cha-om)	Simulaneae	The edible shoots and leaves have a soursour, garlicky taste, which can be considered an acquired taste. According to ECHO Asia staff, shoots harvested during dry season have the best flavour.	Choose young, tender shoots and tips. Be wary of small thorns on the stem when breaking off tips with your fingers. They will keep for 1-2 days without refrigeration if wrapped in newspaper and kept in a cool, dark place.	Eaten as a vegetable in soups and stir-fried dishes. Northern Thai enjoy soursour vegetable soups generously flavoured with fermented shrimp or fish paste. Pairs well with pickled garlic in complete for an easy meal. Acacia complete commonly eaten with fermented shrimp chili paste or fiery southern Thai sour shrimp soup.	Leaves contain protein, minerals and vitamins.	

<i>Fabaceae</i>	<i>Sesna siamensis</i>	Cassod Tree	ก้านกล้วย (khan-klap)	Cassod tree shoots and leaves have a bitter taste favoured in northern Thai- land, while its flowers are slightly garlicky tasting.	Shoots, leaves and flowers should be boiled for at least 10 minutes until they turn a dark brown-green colour. The cooking water can be thrown away.	Like cassava greens, blanched cassod tree greens can be prepared with shal- lots, galangal, chilies and coconut milk for a curry commonly eaten in northern Thailand. The greens can also be eaten as a dipping vegetable.	Anti-potential agent in edible flowers.	
<i>Fabaceae</i>	<i>Leucaena diversa</i> <i>Leucaena leucocarpa</i>	Ipi Ipi	มดหมู	The young shoots and leaves are slightly bitter tasting. The young seed pods can taste like green beans. Mature seeds can be made into a fermented product called tempan that is rich in protein.	Shoots and leaves can be eaten fresh. Young seed pods can be blanched 5-10 minutes before eating as a dipping vegetable.	The shoots and leaves can be blanched and eaten as a dipping vegetable, or added to soups, stews and stir-fried dishes. The young pods are blanched and eaten as a dipping vegetable.	Non-conventional source of protein.	Mimosine (an alkaloid) is concentrated in young leaves and seeds and toxic accumu- lation can lead to goiters, hair loss and growth retardation. Eat in moderation.
<i>Fabaceae</i>	<i>Vigna radicata</i>	Mung Bean	ถั่วงอก	Mature seeds can be boiled whole with rice or by itself to make a hearty porridge.	Mature seeds can be eaten whole or hulled and split.	The dried mature seeds are used as a legume and can be cooked mixed with rice. The whole or split legumes can also be prepared as a porridge.	Legume is high in protein (approx 25%).	
<i>Fabaceae</i>	<i>Cajanus cajan</i>	Pigeon Pea	ถั่วงอก (northern) ถั่วงอก (northern)	Pigeon pea seeds and pods have a distinctive taste - nutty and sweet. The seeds have a mealy texture when cooked.	Young green seed pods can be blanched and eaten as dipping vegetable.	The dried mature seeds are used as a legume and can be cooked mixed with rice. The whole or split legumes can also be prepared as a stew or porridge. The young seed pods can be blanched and eaten as a dipping vegetable.	Source of Vitamin A. Seeds are high in protein.	
<i>Fabaceae</i>	<i>Vigna umbellata</i>	Rice Bean	ถั่วงอก (BKK/fruit) (CM)	Mature seeds and young pods are edible.	Mature seeds can be eaten whole or hulled and split.	The dried mature seeds are used as a legume and can be cooked mixed with rice.	Rich in digestible proteins and also contains minerals, vitamins and amino acids.	
<i>Fabaceae</i>	<i>Sesbania grandiflora</i>	Sesbania	ถั่วงอก/ถั่วงอก ดอกขาว (dark blue)	Sesbania flowers are slightly bitter and the immature seed pods are edible.	Remove the stamens and pistil inside the flowers to avoid the bitter taste.	The flowers can be eaten raw or blanched as a dipping vegetable or added to salads, soups and curries, and stir-fried dishes. The young pods can be eaten as a vegetable in a similar fashion to green beans.	Leaves contain protein, minerals and vitamins.	
<i>Fabaceae</i>	<i>Acacia concarina</i>	Shitakai, Soap Pod Acacia	ถั่วลิสง	The shoots and leaves of this acacia variety can taste as sour as limes.	Remove the stamens and pistil inside the flowers to avoid the bitter taste.	The shoots and leaves can be eaten raw or added to soups and stews to give a sour flavour. The variety of acacia pairs well with fish dishes.	Leaves are rich in carotenoids (Vitamin A and beta-carotene)	

<i>Fabaceae</i>	<i>Canavalia gleditsia</i>	Sword Bean	ถั่วแระ	The immature seeds are starchy like potatoes with a similar flavour. The young seed pods have a similar taste and texture to green beans.	Immature seeds can be boiled and seed coat removed before eating starchy interior.	The young seed pods can be blanched and eaten as a dipping vegetable. Stir-fried as a vegetable. The immature seeds are starchy like potatoes - boil whole and remove the starching inter- ior. Eat mashed or whole in a similar fashion to jackfruit seeds.	The dried legume is high in protein and good source of fiber. The young seeds are high in carbohydrates.	Immature pods should be blanched at least 10 minutes before eating to destroy toxins like phenols and tannins. Dried legumes need to be soaked, boiled and cooking water discarded before eating.
<i>Fabaceae</i>	<i>Tamarindus indica</i>	Tamarind	มะขาม	The unique sweet-sour flavour of tamarind fruit pulp is prized in Southeast Asia. The green immature fruits are mild-tasting while the shoots and leaves are sour.	Choose small, tender leaves and shoots and tips.	The shoots and leaves have a pleasing taste and can be eaten raw in salads or used to add sour flavour to soups and stews. The immature and mature fruits are eaten as a fruit snack. Immature fruits can be powdered into spicy chili pastes. The dark brown pulp from mature pods are used to flavour curries and stews, or mixed with sugar to make drinks and sweets.	Leaves are a good source of beta-carotene, vitamin C and calcium.	
<i>Fabaceae</i>	<i>Labiata purpurea</i>	Vegetable Lablab Bean	ถั่วลิสง	Young lablab seed pods taste like green beans, with a chewy-crisp texture. Mature seeds are roasted to give a nutty taste. The flowers and leaves are also edible. Choose young, tender pods for eating.	The mature seeds are roasted and eaten as a beer snack. The green pods can be stir-fried or blanched and eaten as a dipping vegetable.	The mature seeds are roasted and eaten as a beer snack. The green pods can be stir-fried or blanched and eaten as a dipping vegetable.		Dried seeds need to be soaked or boiled to de-activate any cyanogenic toxins.
<i>Fabaceae</i>	<i>Psophocarpus strygnolobus</i>	Winged Bean	ถั่ว	Young winged bean seed pods are crisp and taste somewhat like asparagus. The mature seeds and young leaves are also edible.	Choose young, tender pods for eating. Remove inedible fibre that runs along length of pod.	The young green pods are eaten raw or blanched as a dipping vegetable or steamed lightly for salads. The leaves can be cooked and eaten as a vegetable.	High protein content and a good source of iron, potas- sium and vitamin B.	
<i>Fabaceae</i>	<i>Vigna unguiculata</i> <i>asynaptophylla</i>	Yardlong/ Asper- agus Bean	ถั่วฝักยาว	Immature seed pods and seeds have a strong bean-like flavour and a tender-crisp texture when stir-fried. The young leaves are also edible.	Choose young, tender pods for eating.	The long pods are eaten raw or blanched as a dipping vegetable or in salads. They can also be ground into chili pastes for a rustic side dish. Best stir-fried, the mid-tasting cooked pods lose their bright green colour and soften excessively. Young leaves are eaten cooked as a vegetable.	Raw pods contain potas- sium, vitamin A and C.	

Malvaceae	<i>Abelmoschus esculentus</i>	Okra	mbisu/mbisi	Young okra pods can be harvested continuously from the plant. They are mild-tasting and mucilaginous, less when raw and more so when cooked. This may or may not appeal to some people! The leaves are sour, like those of the roseleaf plant.	Choose young, tender pods for eating.	The young pods can be eaten raw or blanched as a dipping vegetable with spicy relishes. If stir-fried or added to soups and stews as a vegetable, the pods add a mucilaginous texture to the dish. Add cumin, salt or lime juice to reduce the mucilage.	Raw young pods contain vitamin A and C and calcium.	
Malvaceae	<i>Hibiscus sabdariffa</i>	Rosehip	mbisu/mbisi	The young leaves are slightly mucilaginous, sour in flavour and mildly reminiscent of rhubarb. The young calyces are sour.	Leaves are not usually eaten raw. Remove calyces well to remove any hidden insects.	The leaves can be sundried or used fresh to add a sour flavour to soups and stews or spicy relishes. The dried or fresh calyces are boiled to make an acidic but refreshing drink. Fresh calyces can be used as a substitute for cranberries in Western recipes.	Leaves contain 2-3% protein and traces of calcium, phosphorus and iron.	
Moraceae	<i>Ficus racemosa</i>	Cluster fig	mbisu/mbisi (northern?)	The shoots and leaves are astringent and sour, and the immature fruits are sour.	Shoots and leaves - blanch at least 10 minutes to release latex.	The shoots and leaves must be blanched to reduce latex and to reduce its astringent flavour. Once blanched, the leaves can be eaten as a dipping vegetable, added to soups and stews as a vegetable. The immature fruits can be eaten fresh.	Leaves contain anti-oxidants.	
Moraceae	<i>Ficus verna</i>	Fig Leaf, Red or White	mbisu (northern?)	The shoots and leaves are astringent and sour, and the immature fruits are sour.	Shoots and leaves - can eat raw	The shoots and leaves can be blanched and eaten with spicy dipping relishes or in a salad, or added to soups and stews as a vegetable. The immature fruits can be eaten.	Leaves contain anti-oxidants.	Leaves must be blanched at least 10 minutes to remove latex and tannate phytochemicals.
Moringaceae	<i>Moringa oleifera</i>	Moringa	mbisu	Moringa shoots and leaves have a delicate nutty flavour, and the flowers are mild-tasting. Immature seeds are sweet and bitter, the fibrous seeds pods have an asparagus flavour, and the roots have a sharp horseradish taste.	Young, tender moringa seed pods can be eaten like green beans. Outer layer of older seed pods must be peeled off before eating. There may still be inedible fibrous cellulose attached, but cleaned pods can still be used for eating. Inner flesh of pods is sucked out while eating.	Shoots, leaves and seed pods are added to soups and stews as a vegetable, or eaten blanched or raw with dipping sauces. The seed pods are fibrous but still edible. Seeds may be pre-soaked for oil which has a nutty flavour.	Leaves are high in protein, calcium, vitamins A/B/C, good source of methionine and cysteine (multi-sulphur amino acids).	Tannins found in leaves may combine with proteins and limit usefulness as protein source.

Moraceae	<i>Musa x paradisiacal</i>	Banana	mbisu	Wild forest banana stems and blossoms have a delicate, floral flavour. Domesticated varieties are edible as well. If commonly eaten in your area, ask community members which varieties they prefer as some varieties are less appealing than others.	To prevent browning or oxidation after cutting, wash cleaned hearts in water to which salt or acid (lime or buttermilk) is added. Flower hearts can be massaged after slicing to produce a creamy texture.	Stem hearts are eaten as a vegetable in soups, particularly in the Burmese noodle soup made with cashew called moshinga. Flower hearts can be blanched and eaten in salads.	Fruit is high in potassium and other minerals. The stem is a good source of fiber, potassium and vitamin B6. The flower has vitamins, flavonoids and proteins.
Piperaceae	<i>Piper nigrum</i>	Leaf Pepper	mbisu (central)	Shoots and leaves have a slightly peppery and astringent taste that gives dishes a distinct flavour.	Pick leaves off the stem and use whole or shredded in dishes.	Leaf pepper can be added to soups and stews for flavouring. The whole leaf can be used to wrap other edible ingredients for a savoury snack. The woody stem is frequently used to add a warm, peppery flavour to upland stews.	Rich in flavonoids, calcium, iron, vitamin B. Research has shown it has anti-diabetic properties.

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