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A Study on the Biodiversity of Natural Food Production to Support Community Upstream of Chi Basin, Thailand

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Abstract

This biodiversity study of natural food production to supporting the communities upstream of Chi River Basin aims at collecting the name and species of natural food plants in the forest around the upstream areas of Chi River Basin. This is a phenomenal study of species and potential benefits of forest food. Qualitative methodology was mainly used to collect data; the study relied on the knowledge of the local people had to recall the local data, which significantly focused on the species of natural food plant. The study site was located in the Nongbuadaeng district of Chaiyaphum province, Thailand. It was found that almost all the villagers in the Isaan region (northeastern Thailand) are in the agricultural sector, growing cash crops, such as cassava and sugarcane, the farming of which has affected deforestation and therefore natural food production since the forest is the source of local food. The research focused on species of natural food plants in the community upstream of the Chi River Basin. The information of natural food production biodiversity is in a database for use as guidelines for introducing natural conservation in food security planning with sustainable livelihood in the future. The biodiversity of natural food production to support the community in the upstream forest of the Chi River Basin has 109 species, which can be separated into the following categories: tree (22.9%), plant in wetlands (20.18%), climber (19.27%), mushroom (19.27%), shrub and annual crops (12.84%), and bamboo (5.50%). The taste of natural food plant production includes 5 tastes: tasteless, bitter, astringent, sour, and spicy, and how plants are used for food depends on the species of plant. However, almost all natural food in the forest are seasonal products; for example, the bamboo shoot villagers can collect the whole year, while fruits primarily flourish between August and September.

Keywords: natural food production, upstream, chi basin

1. Introduction

The Isaan region (northeastern Thailand) encompasses 170,218 square kilometers (Simaraks et al., 2003), and agriculture is its main economic activity. Because of socioeconomic conditions and the hot, dry climate, its output lags behind other parts of the country (Kroeksakul et al., 2011). Isaan is Thailand's poorest region (Simaraks et al., 2003; Mongkolsawat, 2006; Kroeksakul et al., 2011). In addition, rainfall in the Isaan region averages between 1,200 and 1,300 millimeters per year (Royal Irrigation Department, 2006), so farmers there grow agricultural products that they can produce in the rainy season (Aunno, 2003). Agriculture production in Isaan changed in 1961 when the government enacted a policy to expand the agriculture area in that region. Farmers then began growing cash crops, such as cassava and sugarcane during Thailand's first four national economic and social development plans (Tongpan, 1993). The Isaan region has 2 main river basins: the Mekong-Chi and Mun river basins.

The Chi River has a rise in the Petchabun range. Its area is 49,131.92 square kilometers (4,913,192 hectares) covering 14 provinces in the region. According to a report by the Land Development Department (2009) for land use in the basin, the area can be divides into 7 parts: 1) paddy field (40.86%); 2) agronomy (21.01); 3) forest (20.48%); 4) other, such as a residential area or water body (13.24%); 5) orchard and trees (3.34%); 6) other agriculture area, including livestock and aquaculture (0.55%); and 7) vegetables (0.11%). According to a report by the Hydro and Agro Informatics Institute (2013), there are 3 problems of the basin. Firstly, encroaching on forests causes soil erosion, shoal river, and decreasing water quality. Secondly, soil conservation and soil fertility

were affected by agriculture practices. Thirdly, the increasing population and industry impact land and water management. However, the report presented an empirical problem in its consideration of these impacts that started in 1961 with the increased agriculture in the forest area and to the resulting decrease of biodiversity in the upstream area, affecting the products from the forest that support villagers, such as food and wood (Wilkie et al., 2003).

The upstream forest of the Chi River serves as the food bank of villagers within the community because most villagers use the forest for natural food production, as many call the forest the "resource of local food." A Communications Foundation report (2008) presents an idea of local food systems describing a method of food production and distribution that is geographically local rather than national and/or international.

Many villagers use products from the forest to support their families, but we never collect data about what types of species they collect, which led us to the research question, "What are the species of natural food plants in the community upstream of the Chi river basin that villagers collected?" The answer will describe the biodiversity of plants used to make food to support the villagers in the community around the upstream zone of the Chi River. The research objective, then, is to collect the names and species of natural food plants in the forest upstream of the Chi River. The data of the biodiversity of food plants will provide guidelines for introducing natural conservation in food security planning with sustainable livelihood in the future. We choose Nongbuadaeng district, Chaiyaphum province, as a research area because it is located in the upstream zone of the Chi river basin.

2. Literature Reviews

2.1 The Community in Upstream River Basin

Forested catchments supply a high portion of the water for domestic, agricultural, industrial, and ecological needs in both upstream and downstream areas (Calder et al., 2004). The upstream river basin almost is a high land zone, so many area farmers do swidden agriculture or shifting cultivated for product a cash crops (Rambo, 1980). However, the activities of villagers in the upstream river basin have direct and indirect impacts on the downstream community (Graversen, 2011). Villagers who live upstream use chemical pesticides on their crops, and it is possible that the chemicals contaminate the river and flow downstream (Visuthisamajarn & Kroeksakul, 2011). However, Pandit et al. (2007) found that the upstream users conflict with downstream users of land, forest, and water because of there is limited access, and they use similar natural resources.

2.2 Indicator Form of Biodiversity and the Food Systems

Biodiversity is enough to promote system stability at the scale which biodiversity should be promoted, so it can consider the individual species level and diversification at the community level (Snapp, 2008). However, the level of biodiversity in the forest is a component of sustainable agricultural and food security indicators (Food and Agriculture Organization of the United Nations [FAO], 2013), and FAO (1996) reported that wild plants, animals, tree foods, and forest foods are essential for many rural households. At least one billion people thought to use them. For instance, in Ghana, over 300 leaves species of wild plants and fruits are consumed. In rural Swaziland, wild plant foods provide a greater share of the diet than domesticated cultivars. About 150 wild plants have been identified as sources of emergency food In India, Malaysia, and Thailand. In developed countries, wild food plants also have an important place. In Italy, mushroom and forest-fruit gathering is popular, and wild food is featured on menus of fashionable restaurants throughout North America and Europe.

2.3 Perception of Sustainable Livelihood Systems

Sustainable livelihood approaches are based on evolving thinking about poverty reduction, the way that the poor live their lives, and the importance of structural as well as institutional issues (Duangjai et al., 2013). Chamber (1989) noted that the perception of farmers is that they will accept the use of technology if in harmony with their livelihood system. Outside factors can also affect farmer behavior adoption and perception for decisions (Chamber, 1985). One important reason for the success of the sustainable livelihood approach in finalizing the attention of key policymakers in donor institutions was that it offered a fresh vision of a holistic and/or integrative approach with the capacity to analyze and understand the complexity of rural development (Knutsson, 2006; Solesbury, 2003). The UK's Department for International Development (DFID) developed the concept of a sustainable livelihood framework in 1999; it presented the relationship of activity with livelihood assets in the community as well as human capital, natural capital, financial capital, physical capital, and social capital. Nevertheless, the concept of a sustainable livelihood has to be the outsiders' perception of the community, because community is complicated by how it relates to livelihood systems. However, the evaluation principle of

sustainable livelihood systems is very important for understanding in content and condition of community before assessing the main indicators because of its relation to the natural resources and culture (Macdonald et al., 2012).

2.4 The Chi River Basin

The Chi River Basin, situated in the Isaan region of Thailand, at latitudes 15°30′ and 15°30′ north, longitudes 101°30′ and 104°30′ east. The Chi River Basin topography comprises high mountain ranges, with the Phupan range in the north and east region, and the Dongphayayen range in the west region. The middle part is plain and features undulation from north to south. The area covers 49,131.92 square kilometers (4,913,192 hectares). The Chi River is the longest river in Thailand at 946 kilometers long. The river rises in the Petchabun range, runs east though the provinces of Chaiyaphum, Khon Kean, and Mahasarakham, turns south in Roi Et, and flows though Yasothon to meet the Mun River in the Kanthararom district of Sisaket province, about 100 kilometers upstream from the confluence with the Mekong River (Kuntiyawichai, 2012). The Chi River Basin has an average temperature of 27 degrees Celsius, average humidity of 71%, and average evaporation of 1,771.3 millimeters (Global Water Partnership Southeast Asia, 2013).

3. Methodology

This is a phenomenal study of species and benefits of forest food. The qualitative methodology was mainly used because the local people were relied on to recall the local data, which significantly focused on the species of natural food plant. The recorded characteristics of diversity in the upstream forest were type of food plant, local name, part of plant for cooking and the scientific name of the plant, needed to check data.

3.1 Study Site and Content

Nongbuadaeng district (Figure 1.) is one in 16 districts of Chaiyaphum province at latitudes 16°4′54’’north and longitudes 101° 48′12"east-an area characterized by a high land with areas higher than sea level by about 300-650 meters and a mountain top as high as 1,020 meters from sea level. Nongbuadaeng district covers 2,215.5 square kilometers (221,550 hectares) and has a population of 98,067 with 16,789 households. Villagers are mainly in the agriculture sectors: in the paddy fields and farming cash crops such as sugar cane, cassava, kenaf, and para rubber. Almost all the people in the district are Buddhist, and they use the Isaan language for communication. Isaan is the collective name of the dialects of the Lao language that they speak in Thailand. Isaan is spoken by approximately 20 million people who live and/or come from the Isaan region of Thailand (Kroeksakul et al., 2011).

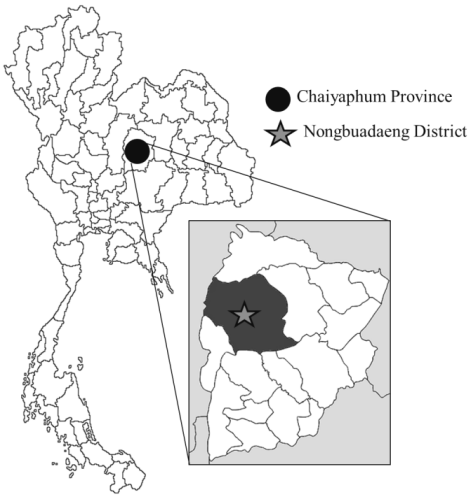

Figure1. Study site

3.2 Data Collection

The data for collection:

1) Secondary data were collected from the local government, including a map online and a textbook on Thai botany.

2) Primary data were collected from main key informant interviews, such as the village senior and village headman. All of the information will be checked via a group interview. The tools for corrected data were applied from rapid rural appraisal (RRA), such as a field notes, records, and semi-structured interviews (SSI) (Simaraks & Suphatera, 1980), as well as covering all plant inventory (Duangjai et al., 2013)

Key information for collecting data:

1) Ten local wisdoms on local vegetables upstream of Chi river basin

2) Two government officers from Tard Thon National Park

3) Seven village headman

4) Forty villagers who collect production from forest

3.3 Conceptual Framework

This is a phenomenal study focusing on species of plants known by villagers who collect natural food plants in the upstream forest and their method for cooking. However, the data are set for their information to be checked against biodiversity rates and the villagers' food consumption rates, which will be gathered from the data bank in the community. The conceptual framework is shown in Figure2.

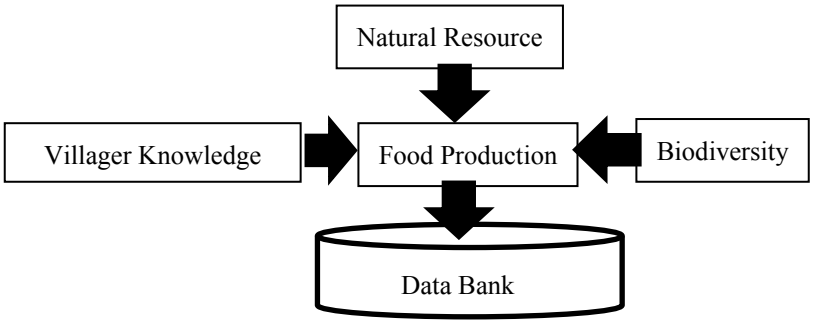

Figure 2. Conceptual framework

4. Result and Discussion

4.1 Biodiversity of Natural Food Production

There are 109 species of biodiversity of natural food production that support the community in the upstream forest of the Chi River, including 25 species of tree (see Table 1), 14 species of shrubs and annual crops (see Table 2), 21 climber species (see Table 3), 22 species of wetlands plants (see Table 4), 21 mushroom species (see Table 5), and 6 species of bamboo shoots (see Table 6). However, Sriphairot et al. (1994) found that there are 162 species of consumable natural plants in Isaan, and Klongtum et al. (1994) made a survey of the local market downstream of the Chi River Basin and found 48 species of natural food plants, comprising 30 land species, 14 water species and 4 wet lands species.

4.2 The Taste and Organ of Natural Food Plant Production

Five tastes of natural food plant production were found, which was similar to the result of Sriphairot et al. (1994): tasteless, bitter, astringent, sour, and spicy. There is also a component of plant use for making food, for example from plants such as the "broken bones tree" or Teak (*Oroxylum indicum* (L.) Kurz). Its leaf will be used, and the pod is fresh for eating. The common name of Keelek Kok is American Cassia. Golden Wonde (*Cassia garrettiana* (Craib.) Inwin & Basneby) is also used; its leaves can be boiled for cooking, and the villagers will know how to keep and use these plants for cooking.

4.3 Production of Upstream Forest from Perennial for Food Support

There are 25 perennial species of upstream forest food production that use leaves, pods, fruit, and bark for eating. The types of foods eaten include fresh vegetables and soups, as well as grilled, soft-boiled, boiled, and steamed foods. The species of trees can make a food shown in Table1.

Table 1. Production of upstream forest perennial forms for food support

Local Name	Common Name	Scientific Name	Part used to make a food	Taste	Type of food
Linfha, Linmai, Pheka	Broken Bones Tree, Teak	*Oroxylum indicum* (L.) Kurz	Leaves, pod	Bitter	Fresh vegetable
Seaw, Somseaw	Showy orchid tree	*Bauhinia malabarica* Roxb.	Leaves	Sour	Fresh vegetable Used in soup for the sour taste
Keelek	Cassod tree, Thai copper pod	*Cassia siamea* Britt.	Leaves	Bitter	Leaves used in soup
Keelek Kok	American Cassia, Golden Wonder	*Cassia garrettiana* (Craib.) Inwin & Basneby	Leaves	Bitter	Use leaflet make a soup.
Pakteiw, Pakteiw kwaw, Pakteiw som	N/A	*Gratoxylum formosum*(Jack) Dyer	Leaves and flower	Sour	Fresh vegetable Used in soup for sour test
Pakwanpha	N/A	*Melietha suavis* Pierre	Leaves and flower	Softsweet	Fresh vegetable Fried vegetable Soft-boiled Grilled Leaves used in soup
Pak Kradon	Tummy-wood, Patana oak	*Careya sphaerica* Roxb.	Leaves and flower	Astringent	Fresh vegetable
Pak Kradon Nam	Indian oak, Chee	*Barringtonia acutangula* (L.) Gaertn.	Leaves and flower	Astringent	Fresh vegetable
Carena, Carepha, Careyai	D.longissima Schum D.rheedii Seem.	*Dolichandrone spathacea* Schum	flower	tasteless	Stream soft-boiled
Mark Kok	Hog plum	*Spondias bipinnata* (L.f) Kurz	Fruit and leaves	Sour Astringent	Leaves as vegetable Fruit as seasoning for cooking
Sommong	Cowa	*Garcinia cowa* Roxb	Leaves	Sour	Fresh vegetable Used in soup for sour test.
Pakmak	N/A	*Syzygium gratum* (Wight) S.N. Mitra var. *gratum*	Leaves	Sour	Fresh vegetable
Pak mead aer	Kulis (Sbl.)	*Memecylon edule* Roxb.	Leaves	Astringent	Fresh vegetable
Yorban	Indian mulberry	*Morinda citrifolia* L.	Fruit and leaves	Astringent	Fresh vegetable Salad
Matoom	Bael Fruit Tree	*Aegle marmelos* (L.) Correa ex Roxb.	Fruit and leaves	Astringent	Fresh vegetable Fruit dry for make a juice
Sang	wood apple	*Feroniella lucida* (Scheff.) Swingle	Fruit and leaves	Sour	Fresh vegetable Fruit is seasoning for soup

Local Name	Common Name	Scientific Name	Part used to make a food	Taste	Type of food
Carekwaw, Carebaab	Sesban Agasta	*Sesbania grandiflora* L. Desv.	Flower and bark	Tasteless (Flower) Astringent (Bark)	Flower steamed or soft-boiled Bark broiled for soup
Mayom	Star Gooseberry	*Phyllanthus acidus* Skeels	Fruit and leaves	Sour	Fresh vegetable
Maroom	Horse radish tree, drumstick	*Moringa oleifera* Lam	Leaves and pod	Tasteless and softsweet	Stream Soft-boiled Broil
Madier	Cluster Fig	*Ficus racemosa* Linn.	Fruit and leaves	Sour	Fresh vegetable
Uktiuk	Khago, woman's tongue [English]	*Albizia lebbeck* (L.) Benth	Leaves and flower	Tasteless	Steam Softbroile
Sathon	NA.	*Milletia* sp.	Leaves	Tasteless	Leavesare vegetable Leaves fermented for soup
Kraset	Horse tamarind, Leucaena.	*Leucaena glauca* Benth	Leaves and pod	Tasteless	Vegetable
Phiman	NA.	*Acacia tomentosa* Willd.	Leaves	Tasteless	Vegetable
Pakjan	Eagle Wood	*Millettia brandisiana* Kurz	Leaves	Tasteless	Vegetable

4.4 The Shrub and Annual Crops Are Natural Food in Upstream Forest of Chi River Basin

There are 14 species of shrubs and annual crops from the upstream forest that can be used in food production. The villagers use the leaves and fruit to prepare vegetables, soups, boils, and steamed food. The species of shrub and annual crops can make foods shown in Table 2.

Table 2. Production of upstream forest in chi river basin forms from the shrub and annual crops for food support

Local Name	Common Name	Scientific Name	Part used to make a food	Taste	Type of food
Pakwanban	Sauropus androgynus; katuk; star gooseberry; sweet leaf	*Sauropus androgynus*	Leaves and fruit	Tasteless	Fresh vegetable Fried vegetable Soft-boiled Leaves for soup
Tourhea	Angola Pea, Congo Pea	*Cajanus cajan* (L.) Millsp	Pod	Tasteless	Fresh vegetable
Buk-Uk	Solanum; Bolo maka; coconilla; tapirillo; groseillier-diable; groseille sauvage	*Solanum stramonifolium* jacq	Fruit	Sour	Use fruit to make a chili sauce
Paksian	Wils Spider Flower	*Cleome gynandra* L.	Leaf and flower	Tasteless	Paksian must be fermented before eating because it is toxic

Local Name	Common Name	Scientific Name	Part used to make a food	Taste	Type of food
Pakrad or Paktumhu	Para Cress	*Spilanthes acmella* Murr.	Leaf and flower	spices	Fresh vegetable Use leaves make soup
Paklinpii	N/A	*Emilia sonchifolia* (L.) DC.	Leaf and flower	Tasteless	Fresh vegetable
Mak Keangkom or Mak Keangkrear	Pea Eggplant	*Solanum sanitwongsei Craib*	Fruit	Bitter	Fresh vegetable
Sanow	Hemp Fesbania	*Sesbania aculeate*	Flower	Tasteless	Soft-boiled
Pak Kha	Acacia; Acacia Pennata	*Acacia pennata (L.)* Willd.Subsp.Insu avisNielsen	Leaves	Bitter	Fresh vegetable Use leaves for soup
E-rok	N/A	*Amorphophallus* spp. Arisaema spp.	Leaf stalk	Tasteless	Use leaf stalks for soup
Husia	Indian borage	*Plectranthus amboinicus* (Lour.) Spreng.	Leaves and softfruit	Astringent	Fresh vegetable
Dook oung	N/A	*Erythroxylum cuneatum (Miq.)* Kurz	Leaf	Astringent	Fresh vegetable
Pak Tangmong	NA.	*NA.*	Leaves	Astringent	Fresh vegetable
Pak Keankom	NA.	*NA.*	Leaves	Tasteless	Soft-boiled

4.5 The Climber Is Natural Food in Upstream Forest of Chi River Basin

There are 21 species of upstream forest food produce from the climber that are used for food support. The leaves and fruit are prepared as fresh vegetables, soup, boils, and streamed foods. The species of climber can make foods shown in Table 3.

Table 3. Production of upstream forest forms from the climber, used for food support

Local Name	Common Name	Scientific Name	Part used to make a food	Taste	Type of food
Pak Sai	Wild Bitter Gourd; Balsam Apple; Balsam Pear; Bitter Cucumber; Bitter Gourd; Carilla Fruit	*Monordica charantia* Linn.	Leaf top and fruit	Tasteless	Fresh vegetable
Sai tan	Burkill	*Aganosma marginata* G.Don	Leaf top and fruit	Bitter	Fresh vegetable
Krear kai ngor	Wild Orange-Tree, Lopea Tree, Forest-Pepper	*Toddalia asiatica* Lamk	Leaf top and fruit	Bitter	Fresh vegetable

Local Name	Common Name	Scientific Name	Part used to make a food	Taste	Type of food
Pak krad ya	NA.	*Caesalpinia mimosoides* Lam.	Leaf	Spices	Fresh vegetable
Dok kig or Slid	Cowslip creeper	*Telosma minor* Craib	Leaf top and flower	Tasteless	Fresh vegetable Steam Soft-boiled
Pak pang	Ceylon spinach	*Basella alba* Linn	Leaf top and flower	Tasteless	Fresh vegetable Soft-boiled Use leaf or flowers for soup
Pak srab	N/A	*Adenia viridiflora* Craib	Leaf top and fruit	Tasteless	Soft-boiled
Bak pap	bonavist; Hyacinth Bean	*Laplap purpureus* (L.) Sweet	Leaf top and fruit	Astringent	Fresh vegetable Soft-boiled
Som lom	NA.	*Aganonerion polymorphum* Pierre ex Spire	Leaf	Sour	Fresh vegetable
Tamyan	NA.	*Streptocaulon juventas* (Lour.)	Fruit	Astringent	Fresh vegetable
Yanang	yanang; Tiliacora triandra	*Tiliacora trianda* Diels.	Leaf	Astringent	Use leaf spine and filter before make a soup
Krea manoi	N/A	*Cissampelos Pereira* Linn.	Leaf	Tasteless	Use leaf spine and liquid for a jelly
Pak ereart	Piper Samentosum	*Piper sarmentosum* Roxb.	Leaf	Spice	Fresh vegetable Use leaves for soup
Pak oumsrab	NA.	*Justicia Gangetica*.	Leaf	Tasteless	Use leaves for soup
Sompoi	Soap Pod	*Acacia concinna* (Willd.) D.C	Leaves	Sour	Use leaves for soup
Pak pralai	Rosy Milkweed	*Sarcostemma secamone* (L.) Bennet.	Leaf	Bitter	Fresh vegetable
Pakmaia	Dodder	*Cuscuta chinensis* Linn.	Root to leaf (all parts)	Tasteless	Fresh vegetable Soft-boiled
Pak keenak	N/A	*Erythropalum scandens* BL.	Leaf	Bitter	Fresh vegetable
E-jor	N/A	*N/A*	Flower	Tasteless	Soft-boiled
Tumliungpha	N/A	*N/A*	Leaves	Bitter	Soft-boiled
Pak drangphan	N/A	*N/A*	Leaves	Bitter	Soft-boiled

4.6 Wetlands Plants That Are Natural Food in Upstream of Chi River Basin

There are 22 species of upstream forest food production from the wetlands used for food support. The villagers eat leaves and fruit as fresh vegetables, soup, boiled and steamed foods. These species of wetland plants can make the foods shown in Table 4.

Table 4. Production of upstream forest wetlands forms used for food support

Local Name	English Name	Scientific Name	Part used to make a food	Test	Type of food
Pak wan	Water Fern	*Marsilea crenata* Prel.	Leaf	Astringent	Fresh vegetable
Pak kranjong	Tummy-wood	*Limnocharis flava* Buch.	Leaf stalk	Tasteless	Fresh vegetable
Pak krachednaam	Water Minosa	*Neptunia oleracea* Lour.	Leaf stalk	Tasteless	Fresh vegetable Fried vegetable
Pak kud	Oak fern.	*Diplazium esculentum*	Leaf stalk	Tasteless	Soft-boiled Fried vegetable
Pak naam	Lasia spinosa	*Lasia spinosa* Thw.	Leaf top and flower	Tasteless	Soft-boiled Steam
Bourdang	Water lily.	*Nymphaea lotus* Linn.var.Pubesens Hook.f.&Th.	Stem	Tasteless	Fresh vegetable Stem for soup
Pak tobjawa	Water hyacinth	*Eichlornia crassipes* Solms	Flower and leaf stalk	Tasteless	Soft-boiled
Thao	Fresh Water Algae	*Spirogyra* sp.	Algae	Tasteless	Fresh algae Make a salad
Kaipwam	Water Meal, Swamp Algae	*Wolffia arrhiza* (L.) Wimm.	Granule	Tasteless	Used for soup
Pak krayang	Finger grass.	*Limnophila aromatica* Merr.	Leaf and stem	Bitter	Used for soup.
Pak kato or Pak hop hap	N/A	*Ottelia alismoides* (L.) Pers.	Leaves	Tasteless	Fresh vegetable
Pak E-heen	Monochoria, Pickerel weed	*Monochoria vaginalis* (Burm.f.) Presl.	Leaves	Spice	Fresh vegetable
Pak liumphour	N/A	*Limnophila aromatica* (Lomk.) Merr.	Leaf and stem	Tasteless	Fresh vegetable
Pak Nork	N/A	*Centella asiatica* (Linn.) Urban	Leaf and stem	Bitter	Fresh vegetable
Pak Chinam or Pak Chirom	Water dropwort	*Oenanthe stolonifera* DC.	Top leaf and flower	Bitter	Fresh vegetable
Pak Chichang	N/A	*Artemesia* sp	Leafless and flower	Bitter	Fresh vegetable
Ngearkpramore	Sea holly	*Acanthus ebracteatus* Vahl.	Leafless	Bitter	Fresh vegetable
Pakload	N/A	*Monochoria hastate* (L.) Solms	Flower	Tasteless	Soft-boiled
Pakbung	Morningrory	*Enydrafluc tuans* Lour.	Leaf and stem	Tasteless	Fresh vegetable
Pak tubtwaw, Tubtwawnaam	Frogbit	*Hydrocharis morsus ranae* Linn.	Leaf and stem	Tasteless	Fresh vegetable
Pakpai	Vietnamese Coriander	*Polygonum odoratum* Lour	Leaf	Tasteless	Fresh vegetable
Pakpire	Yellow Burt Head	*Limnocharis flava* Buch.	Leaf and stem	Tasteless	Fresh vegetable

4.7 Mushrooms in Upstream Forest of Chi River Basin

The villager can collect mushrooms primarily during the early rainy season. According to information from interviews, we found 21 species of mushrooms that villagers collect for cooking, as shown in Table 5.

Table 5. The mushroom species in upstream forest of chi river basin

Local Name	Scientific Name	Type of Food			
		Boiled	Streamed	Grilled	Fried
Hed ra ngok	*Polygonum vaginata.*	√	√		
Hed trakai	*Russula delica* Fr.	√	√	√	
Hed prouk	*Termitomyces Grobuslus* Helm et Grooss.	√		√	
Hed ping	*Heimiell retispora* (Pat, and Bak.) Boedijn.	√	√		
Hed prouk	*Astraeus hygrometricus*	√	√		
Hed humphan	*Mycoamaranthus cambodgensis* (Pat.)			√	
Hed kor	*Russula emetic* (Schaeff.Ex Fr.) Pers. S.F. Gray.	√	√		
Hed tran	*Russula nigricans* Fr.		√		
Hed teenhad	*Tricholoma crassum* (Berk.) Saccardo.	√		√	
Hed tad	*Diminutive agaricus*	√	√	√	
Hed manphu	*Cantharellus cibarius.*	√	√	√	√
Hed kradang or Hed bod	*Lentinus polychrous* Lev.	√	√	√	√
Hed tapu	*Pisolithus tinctorius* Pers.	√		√	
Hed naam mark	*Russula* Sp.	√	√		
Hed narea	*Russula cyanoxantha* Schaeff.	√	√		
Hed kha	*Lactarius piperatus* (Scop. ex Fr.)	√	√		
Hed konkrok	*Russula cascadensis* Schaeffer.	√	√		
Hed saidiun	*Amanita* sp.		√		
Hed nakwaw	*N/A*	√	√		
Hed bankum	*N/A*	√		√	
Hed houya	*N/A*	√	√	√	

4.8 Bamboo Shoot in Upstream Forest of Chi River Basin

The villagers can collect bamboo shoots the whole year, but they are most plentiful between August and September. In the collected information from interviews, we found that there are 6 species of bamboo that villagers collect for cooking, as shown in Table 6.

Table 6. The bamboo species and availability by month in upstream forest of chi river basin

Species of Bamboo shoot	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Thyrsostachys siamensis												
Gigantochloa albociliata												
Bambusa nutans												
Dendrocalamus strictus												
rundinaria cilita												
Bambusa sp												

More collection Less collection Bit collection

5. Conclusion

Almost all villagers in the Isaan region (northeastern Thailand) work in the agriculture sector, growing the cash crops such as cassava and sugarcane. The heavy agriculture has led to deforestation and natural food production, as the forest is "the source of local food." However, this study has focused on species of natural food plants in the community upstream of Chi river basin. The information of natural food production biodiversity is in a database to be used as guidelines of natural conservation, providing a foundation for food security planning with sustainable livelihood in the future. Nongbuadaeng district was determined for a study area. The biodiversity of natural food production for the supporting community in the upstream forest of Chi river basin consists of 109 species, classified as trees (22.9%), wetland plants (20.18%), climbers (19.27%), mushrooms (19.27%), shrubs and annual crops (12.84%), and bamboo (5.50%). There are 5 tastes of natural food plant production: tasteless, bitter, astringent, sour, and spicy, and a component of plants for preparing food depends on the species of plant. However, almost all natural foods in the forest are seasonal products, such as the bamboo shoot, which can be collected the whole year, but with the most products being collected between August and September.

References

Aunno, A. (2003). *Sustainable agriculture of Thai social*. Thailand, Nonthaburi: Sustainable agriculture foundation.

Calder, I., Hofer, T., Vermont, S., & Warren, P. (2004). *Towards a new understanding of forests and water*. FAO Corporate Document Repository. Retrieved August 14, 2013, from http://www.fao.org/docrep/010/a1598e/a1598e02.htm

Chamber, R. (1985). *Rural development, putting the last first*. Longman Group United, USA.

Chamber, R. (1989). Reversals, institutions and change. In R. Chamber, A. Pacey, & L. A. Thrupp (Eds.), *Farmer First* (pp. 181-193). Intermediate Technology Publications, Southampton, London.

Communications Foundation. (2008). *Local & regional food systemrs*. Food program. Retrieved August 11, 2013, from http://www.sustainableable.org/254/local-regional-food-systems

Department for International Development (DFID). (1999, January 13). *Sustainable livelihoods guidance sheets.* Retrieved January 13, 2013, from http://www.efls.ca/webresources/DFID_Sustainable_livelihoods_guidance_sheet.pdf

Duangjai, W., Ngamniyom, A., Silaprasit, K., & Kroeksakul. (2013). The guideline development for sustainable livelihood indicators of village marginal mangrove forest in the Stun province, Thailand. *Asian Social Science, 9*(9), 123-130. http://dx.doi.org/10.5539/ass.v9n9p123

Food and Agriculture Organization of the United Nation. (1996). *World Food Summit, Food for All*, 13-17. Retrieved August, 14, 2013, from http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/x0262e/x0262e04.htm

Food and Agriculture Organization of the United Nation. (2013). *Targets and indicators for biodiversity for food and agriculture.* Commission on genetic resources for food and agriculture, Item 2.2 of the Provisional Agenda, Fourteenth Regular Session. Rome, 15-19 April 2013. Retrieved August 12, 2013, form http://www.fao.org/docrep/meeting/027/mf863e.pdf

Global Water Partnership Southeast Asia. (2013). *Chi river basin, Thailand*. Thailand Water Partnership. Retrieved January 12, 2013, from http://www.gwpsea-toolbox.net/wapi/mctweb.dll/getObject?MID=TH-TOOLBOX&ObjID=457

Graversen, K. M. (2011). *Regulating water extraction in a river basin with upstream-downstream communities*. FOI working paper 2011/2, Institute of Food and Resource Economics, University of Copenhagen.

Hydro and Agro Informatics Institute. (2013). *Situation of problem with environment and resource of Chi river basin*. Retrieved January 10, 2010, form http://www.hii.or.th/wiki/index.php

Khongtum, P., Taveesarn, T., Sungsen, W., Kongnonnork, C., Janthanam, T., Yongyut, W., & Makkhanan, P. (1994). *A guidelines of vegetable native recover in wet land: Case studies Kudpheng wet land in Yangkham sub-district, Phonsai district, Roi et province, Thailand*. Full report of Local Research, Thailand Thailand Research Fund (TRF).

Knutsson, P. (2006). The Sustainable Livelihoods Approach: A Framework for Knowledge Integration Assessment. *Human Ecology Review, 13*(1), 90-99.

Kroeksakul, P., Sakolnakorn, T. P. N., & Naipinit, A. (2011). The economic and social effects of farmers growing para rubber in northeast Thailand: A case study of Sapsomboon village, Dun Sad sub-district, Kranoun district, Khon Kaen province. *Journal of Business Case Studies, 7*(1), 113-118.

Kuntiyawichai, K. (2012). *Interactions between land use and flood management in the Chi river basin*. Thesis of doctor degree, Academic board of Wageningen University and the Academic board of the UNESCO-IE institute for Water Education.

Land Development Department. (2009). *Report of landuse*. Thailand. Retrieved January 10, 2010, form http://olp101.ldd.go.th/web_plan1/report/53/53_2.doc

Macdonald, B., Rust, C., Thrift, C., & Swanson, D. (2012). *Measuring the performance and impact of community indicators systems: Insights on frameworks and examples of key performance indicators.* IISD report, International Institute for Sustainable Development, Canada.

Mongkolsawat, C. (2006). *Efficiency of Isaan region for development.* Thailand. Khon Kean University: IT center for Northeast region development.

Pandit, H. B., Wagley, P. M., Neupane, P. R., & Raj, B. (2007). Watershed Management and Livelihoods: Lessons from Nepal. *Journal of Forest and Livelihood, 6*(2), 67-75.

Rambo, A. T. (1984). Chaptore 9; No free lunch: A reexamination of the energetic efficiency of swidden agriculture. An Introduction to human ecology research on agricultural systems in Southeast Asia (Editors by Rambo & Sajise). *East-West environment and policy institute and University of the Philippines at Los Banos*, 154-163

Royal Irrigration Department. (2006). *Chi basin*. Thailand. Retrieved December 9, 2009, form http://www.rid.go.th/b4-chi.htm

Simaraks, S., & Suphatera, S. (Eds.) (1987). *Rapid Rural Appraisal manual*. Farming Systems Project, Khon Kaen University, Thailand.

Simarks, S., Suphadhira, S., & Srila, S. (2003). The shifting role of large livestock in norteast Thailand. *Southeast Asian Studies, 41*(3), 316-329.

Snapp, S. (2008). Designing for the long term: Sustainable agriculture. In S. Snapp, & B. Pound (Eds.), *Agriculture Systems: Agroecology and Rural innovation for development* (pp. 89-128).

Solesbury, W. (2003). *Sustainable Livelihoods: A Case Study of the Evolution of DFID Policy*. Working Paper 217. Overseas Development Institute. UK. Retrieved from http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/172.pd

Sriwirot, P., Mekphanorphat, T., & Sriwirot, N. (1994). A studies Nutrition of local plant and vegetable of support villagers in Isaan region. Thailand, Mahasarakham University.

Thongpan, S. (1993). *Thailand policy of agriculture* (Reprint 2th). Bangkok, Lerdchai printing.

Visuthisamajarn, P., & Kroeksakul, P. (2011). *Report: Risk assessment of chemical pesticide in southern, Thailand*. Thai Health Promotion Foundation.

Wilkie, L. M., Holmgren, P., & Castaňeda, F. (2003). *Sustainable forest management and the ecosystem approach: Two concepts, one goal*. Forestry Department, Food and Agriculture Organization of the United Nation.