

## **Preliminary Field Observation of Cultivated Crops and Useful Plants in Northeast India and adjacent northern Sagaing Region of Myanmar**

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### **Summary**

This is a preliminary report of a field observation of cultivated crops and useful plants in marketplaces and of farmers in Meghalaya State, Assam State, and Nagaland State of India in 2013, and in northern part of Sagaing Region where the Naga people inhabit in 2014. The field observation team focused on the areas, because they are located adjacent to the places where series of field studies on plant genetic resources were made recently, e.g. Kachin State and Chin State of Myanmar, northern Lao PDR and northern Thailand. The plants used traditionally for food and agriculture in the target areas might provide valuable information for strategic conservation of plant genetic resources for the future and to understand agriculture basic complex in Southeast Asia and South Asia.

Both non-glutinous and glutinous rice were sold in the marketplaces of Assam, Meghalaya and Nagaland States of India and in Sagaing Region of Myanmar. Glutinous rice is specific to Southeast Asia and East Asia of which Lao PDR has its abundant cultivation area, while it has not been cultivated mostly in countries west of South Asia. Worldwide crops such as radish, broccoli, cabbage, carrot, common pea, eggplant, ginger, and others were also common there. In addition to such popular crops, various shallot plants and other different *Allium* spp., rice bean with various surface colors, *Centella asiatica*, *Elsholtzia blanda*, *Zanthoxylum* sp., and perilla seed were sold in a certain quantity at marketplaces in Dimapur and Kohima, Nagaland and in Homalin, Sagaing. Indian gooseberry, foxtail millet, hog plum and holy basil were also seen in Nagaland. Through interviews, various vernacular names were recorded in Northeast India and in Sagaing Region of Myanmar for certain crops, which were different from area to area in most

cases, and from Hindi words widely used in North India. Traditional uses of rice bean, *Centella asiatica*, *Elsholtzia blanda*, *Zanthoxylum* sp., and perilla and fermented soybean suggested cultural similarity in the range including Nagaland of India and mountainous parts of Myanmar and Lao PDR. The field observation team concluded that minor crop varieties of those areas need to be studied, particularly in scattered Naga villages in Sagaing Region of Myanmar as soon as possible.

## Introduction

Field studies done by the National Institute of Agrobiological Sciences and cooperative institutes on hilly areas of Southeast Asia revealed a large genetic diversity of cultivated and useful plants, while the Northeast India had been focused on by several scientists for their ethnobotanical importance (Jain & Namita Dam 1979; Maikhuri & Gangwar 1993). Genetic diversity of the plants for food and agriculture in the region fringing the hilly and mountainous areas from the Northeast India to Southeast Asia would be well understood by comparing places within the region from a view point of culture complex. Loss of genetic variations of crops in the areas, or threats to genetic erosion might have been caused by urbanization, modernization of agriculture, shifts to other more profitable crops/varieties, and other reasons. Studies on traditional plant genetic resources for food and agriculture are limited in Northeast India and much less in neighboring Sagaing Region (formally called Sagaing Division) of Myanmar.

Agro-biodiversity might be related with diverse cultural elements such as vernacular names, indigenous usages, folk taxonomy, and others. For example, foxtail millet landraces collected with different vernacular names just in northern Pakistan were classified into several clusters with DNA analysis (Kawase *et al.*, 1995; Hirano *et al.*, 2011). Cultural information may guide us to certain areas harboring a wide genetic diversity that should be conserved *ex situ* or *in situ*. Nakao (1966) proposed four independent "Agriculture Basic Complexes" as a theory for processes and geographical origins of agriculture based on his field studies and analytical ones in regards with domestication of cultivated plants and on material culture: Roots and Tubers Agriculture Basic Complex in Southeast Asia and the Pacific, Savanna Agriculture Basic Complex in Sahel and South India, Mediterranean Agriculture Basic Complex in the Fertile Crescent, and New World Agriculture Basic Complex in Mesoamerica and South America. He designated the fifth agriculture basic complex, Laurel Forest Culture Complex ("*Shoyo-Jurin Bunka*" in Japanese) distributed in Southeast Asia, South China and Far East, which he thought a secondary development from the Roots and Tubers Agriculture Basic Complex after it was expanding into the Temperate Zone adopting factors of Savanna Agriculture Basic Complex. It has not been discussed whether it was secondarily developed or not.

Hilly and mountainous areas of continental part of Southeast Asia and South Asia still maintain several traditional crops, in which valuable genetic resources may be found for future utilization, since they should have been well adapted to various biotic and abiotic environment in the region. It is also important to understand cultural complex in those areas, which will provide new information associated with those genetic resources.

A preliminary field observation trip was planned and implemented in Meghalaya, Nagaland and Assam in 2013 and in northern area of Sagaing Region in 2014. Several field studies were already organized in Myanmar by the NIAS Genebank Project of the National Institute of Agrobiological Sciences and University of Tsukuba in cooperation with several institutes on plant genetic resources for food and agriculture (PGRFA) (Uga *et al.*, 2005; Uga *et al.*, 2006; Saito *et al.*, 2006; Watanabe *et al.*, 2007; Watanabe

*et al.*; 2011; Kawase *et al.*, 2011 and Yamamoto *et al.*, 2011) and in Lao PDR (Sakata *et al.*, 2008; Saito *et al.*, 2009; Matsunaga *et al.*, 2010 and Kawase *et al.*, 2012). The PGRFA of those regions showed some similarity to Thailand and Lao PDR but were quite different from those in South India (Kawase 1987, Kawase *et al.* 1995) and Pakistan (Kawase 1989). A considerable gap of material culture was suggested between the Indian Subcontinent and Southeast Asia.

## Observation Methods

### Northeast India

In February 2013 the Japanese members of the field observation team flew from Delhi to Guwahati, the capital of Assam State, and then moved to Shillong, the capital of Meghalaya State. Shillong is located at an altitude of around 1,500 m and much cooler than subtropical India. It is situated at the northern edge of the Khasi hill. The team observed marketplace at Shillong and farmers' places around the city, went south across the hill until near the border with Bangladesh (Table 1 & Fig. 1).

Then, the team traveled from Shillong through Kaziranga that is famous for National Park in Assam, and arrived at Dimapur, Nagaland. They made a short climbing-up trip to Kohima and went south to the border with Manipur State.

The team tried to ask local farmers and shop keepers at marketplaces about crops produced and consumed there such as rice, millets, pulses, and vegetables during the trip. Visiting several villages, the team interviewed villagers asking what kinds of crops they grew, their cultivation practices and utilization. They focused on cereals like rice landraces (mainly upland rice varieties), millets, leguminous crops containing *Vigna* species, indigenous vegetables such as *Allium* species observed in the previous surveys.

Stand crops were rare, because it was the slack season on the farm. When plant materials were found, geographical locations of the sites on the global positioning system (GPS) and the ecological information of the circumferences together with local people's cultivation practices and utilization of the plants were noted. The observation team did not collect any plant materials at all, since permission was not granted by the National Biodiversity Authority in spite of kind efforts made by Dr. K. C. Bansal, Director of the National Bureau of Plant Genetic Resources. We respect sovereign right of India over its natural resources and act in conformity paying a careful attention not to violate the Indian laws.

Table 1. Itinerary of the field study in Meghalaya, Assam and Nagaland States of India in 2013

YY/MM/DD	date	route	night stay	transport
2013/01/31	THU	NRT - DEL	Delhi	air
2013/02/01	FRI	Delhi	Delhi	
2013/02/02	SAT	DEL - GAU	Guwahati	air/car
2013/02/03	SUN	Guwahati - Shillong	Shillong	car
2013/02/04	MON	around Shillong	Shillong	car
2013/02/05	TUE	around Shillong	Shillong	car
2013/02/06	WED	around Shillong	Shillong	car
2013/02/07	THU	Shillong - Dimapur	Dimapur	car
2013/02/08	FRI	around Dimapur	Dimapur	car
2013/02/09	SAT	Dimapur - Kohima	Kohima	car
2013/02/10	SUN	Kohima - Guwahati	Guwahati	car
2013/02/11	MON	GAU - DEL	Delhi	car/air
2013/02/12	TUE	NBPGR*, ICAR**	Delhi	
2013/02/13	WED	NBPGR, ICAR	Delhi	
2013/02/14	THU	DEL -	in flight	air
2013/02/15	FRI	- NRT 0710		air

\*NBPGR: National Bureau of Plant Genetic Resources.

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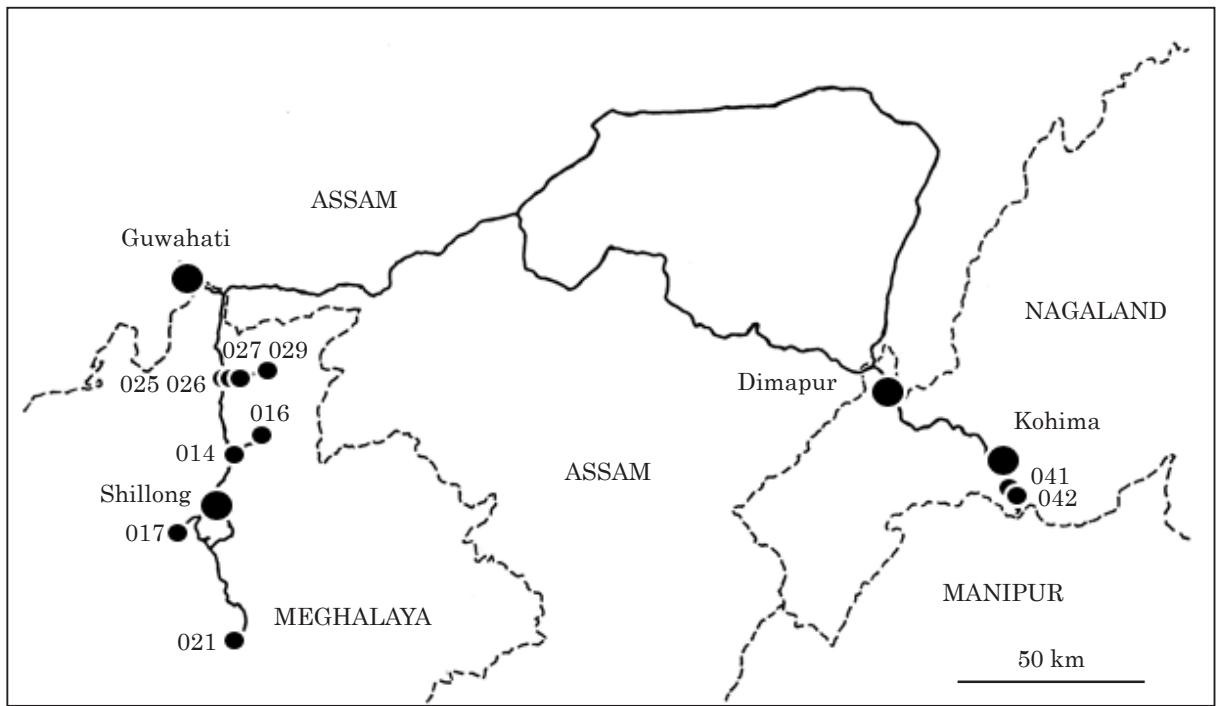


Fig. 1. A map showing routes and some sites of field observation in Meghalaya, Assam and Nagaland States of India in 2013. The number of each site (e.g. 014) corresponds with the number of waypoint (e.g. 2013WP014) in Table 3

### Sagaing Region of Myanmar

In February 2014, the Japanese members of the team flew from Yangon to Homalin (or Hommalinn), which is a small town in northwestern Myanmar and capital of the Homalin Township in Hkamti (or Khamti) District of the Sagaing Region. The town lies on the Chindwin River that serves a good transportation medium connecting north and south in the Region. From Homalin, the team moved upstream to Hkamti by boat. It was late dry season so that the river were nearly the shallowest, which was some five meters lower than the most risen level. The two towns have altitudes of about 130 m and have the backdrop of deep forested high mountains. Agriculture farms at Hkamti and also remote Naga villages in mountainous areas near the Indian border were visited (Table 2 & Fig. 2).

Shop keepers at marketplaces kindly told us about crops produced and consumed there such as rice, millets, pulses, and vegetables during the trip. We also interviewed villagers what kinds of crops they grew, their cultivation practices and utilization. Cereals like rice, millets, leguminous crops containing *Vigna* species, indigenous vegetables such as *Allium* species like the previous surveys in hilly and mountainous areas of Southeast Asia and Nagaland of India.

Stand crops were rarely found on the fields because of the slack season. When plant materials were found or related information were gathered, the geographical locations of the sites based on GPS data and the ecological information of the circumferences were collected together with local people's cultivation practices and utilization of the plants. We did not collect any plant materials at all, since memorandum of understanding for collaborative project between NIAS and DAR came into force after the field study.

Table 2. Itinerary of the field study in Sagaing Region of Myanmar in 2014

YY/MM/DD	date	field study route	night stay	transport
2014/01/30	THU	NRT - RGN	Yangon	air
2014/01/31	FRI	Yangon	Yangon	
2014/02/01	SAT	YGN - HOX	Homalin	air
2014/02/02	SUN	Homalin -	on baot	boat
2014/02/03	MON	- Hkamti	Hkamti	boat
2014/02/04	TUE	Hkamti - Lawngngaw - Hkamti	Hkamti	4x4 vehicle
2014/02/05	WED	Hkamti - Pasang - Kyao Ywe Ywa - Hkamti	Hkamti	4x4 vehicle
2014/02/06	THU	Hkamti - Homalin	Homalin	boat
2014/02/07	FRI	around Homalin	Homalin	car
2014/02/08	SAT	HOX - MDL	Mandalay	air
2014/02/09	SUN	Mandalay - Yezin	Yezin	car
2014/02/10	MON	around Yezin * / Nay Pyi Taw	Yezin	car
2014/02/11	TUE	Yezin - Yangon, RGN -	on flight	car/air
2014/02/12	WED	- NRT		air

\* Visit to Department of Agricultural Research (DAR), Ministry of Agriculture and Irrigation, Yezin, Nay Pyi Taw.

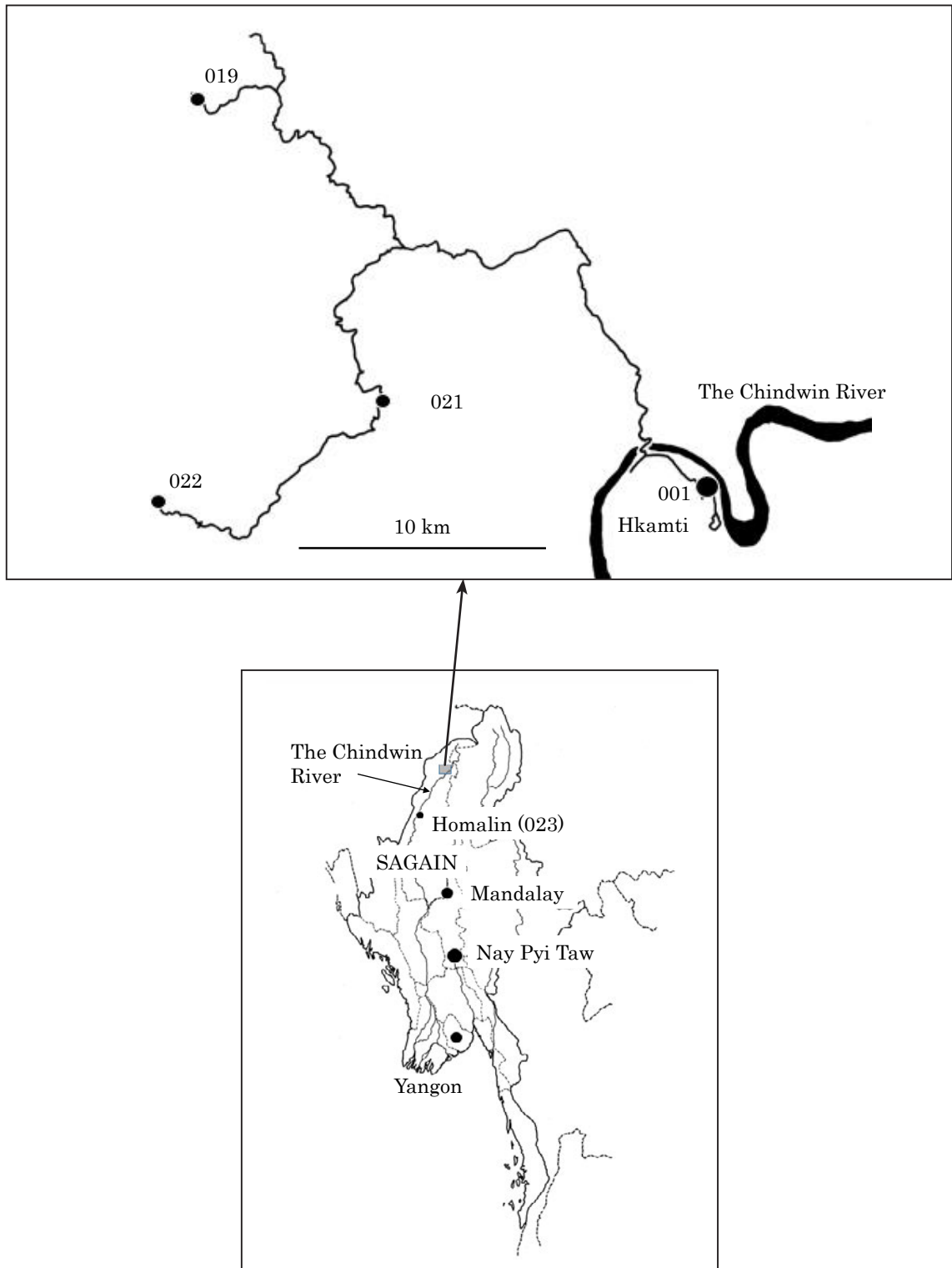


Fig. 2. A map showing routes and some sites of field observation in Sagaing Region of Myanmar in 2014. The number of each site (e.g. 001) corresponds with the number of waypoint (e.g. 2014WP001) in Table 3.

## Results and Discussion

### *Observations of crops grown in Northeast India*

We could make an at-a-glance comparison between Northeast India and South India, and between hill agriculture in Northeast India and that in Myanmar and Lao PDR. Interestingly, glutinous rice (waxy rice) is preferred in Northeast India including Meghalaya, Nagaland and Assam, which is very rarely eaten in other parts of India. Shaptadvipa and Sarma (2009) investigated rice varieties in Assam, from which they revealed two varietal groups of glutinous rice, a semi-glutinous group and a non-glutinous one. This information implies a similarity of Northeast Indian peoples' agriculture basic complex to that of South East Asia.

During a quite short stay at Guwahati, the capital of Assam state, we saw internationally popular crops such as potato, onion, radish, broccoli, cauliflower, eggplant, cucumber, cabbage, carrot, kohlrabi, beet, ginger, green bell pepper, cowpea, common pea, taro, lablab bean, coriander, lemon and mango at a small store. It is interesting to note that glutinous (waxy) were sold at a store and non-glutinous rice (non-sticky rice) grains were also found at another store. This may suggest that the local people recognize glutinous and non-glutinous rice as separate crops.

Similarly, non-glutinous and glutinous rice, maize, rice bean, common pea, kidney bean, lablab bean, sponge gourd, broccoli, Chinese kale, mustard seed, beet, ginger, turmeric, garlic, kohlrabi, taro, onion, cucumber, eggplant, carrot, radish, chili pepper, bell pepper, kidney bean, sesame (white and black), coriander, chayote, tree tomato, star fruit, banana, melon, grape, apple, orange, tobacco leaf, and so on were observed in Shillong, Meghalaya.

Marketplaces at Dimapur and Kohima in Nagaland had a different assortment of crops. We saw that those places were characterized by the fact that various shallot plants and other different *Allium* spp., rice bean with various surface colors, *Centella asiatica*, *Elsholtzia blanda*, *Zanthoxylum* sp., and perilla seed were sold in a large quantity. Indian gooseberry, foxtail millet, hog plum, *Leucaena* sp., and holy basil were traded together with more popular crops such as kidney bean, cowpea, soybean, broad bean, taro, Chinese kale, eggplant, several kinds of mushrooms, black, red and white glutinous rice, black, red and white non-glutinous rice grains, chili pepper of various shapes, coriander, star fruits, pine apple, pomelo, banana, ash gourd, tamarind, papaya, tree tomato, lablab bean, taro, banana bud, bottle gourd, and others. Small animals like frogs, dogs, pigeon, edible insect and pond snail that were hunted and gathered were commonly seen at marketplace.

### *Observations of crops grown in Sagaing Region of Myanmar*

Important information about traditional crops and useful plants in Sagaing Region were obtained in spite of short stay there. Cultivation of maize, groundnut, radish, mustard, and banana on river bank and fishing boats were seen during a boat trip going from Homalin up to Hkamti, of which the distance is about 150 km in a straight line. Skins of deer hunted were dried in a small hut at about 30 km before reaching Hkamti, where fishing nets were put in a small boat and free range pigs and chicken were walking in the garden. So they were hunting, fishing, keeping a poultry, growing crops and breeding pigs on the river bank.

Both Homalin and Hkamti are located on the Chindwin River, where agricultural farms looked not so different from many other townships in Mandalay Region and Shan State. Farmers are managing their fields neatly where new cultivars of rice and/or vegetables were insensitively introduced to and grown



there. On the other hand, the local marketplaces at Homalin and Hkamti sold various agricultural products harvested and processed in the mountainous areas surrounding the towns. Many patches on mountain slopes were used for slash-and-burn cultivation or shifting agriculture, where both non-glutinous (non-waxy) and glutinous (waxy) rice, sesame, maize, taro, sorghum, chili pepper, lablab beans, roselle, coriander, holy basil, and *Elsholtzia blanda* had been widely planted but already harvested in almost all places when we visited. We perceived that peoples in Sagaing and in Nagaland of India has a certain similarity in cultivating both glutinous and non-glutinous rice, *Vigna umbellata*, coriander, holy basil, *Elsholtzia blanda* and many other crops. *Vigna umbellata*, fermented soybean and *Zanthoxylum* sp. are very popular in Nagaland of India and exist but not so much at Homalin and Hkamti in Sagaing. Fermented soybean is more commonly used in other places of Myanmar, for example, Shan State. We observed several unidentified wild vegetables in Homalin marketplaces, too. More observation in Sagaing Region should be needed.

#### *Similarity of some cultivated plants between Northeast India and Myanmar*

It is noteworthy the resemblance in crops like shallot and other *Allium* spp., rice bean, *Zanthoxylum* sp., holy basil and *Elsholtzia blanda* in the Northeast India with those in hilly areas of Lao PDR and Sagaing Region and Kachin State of Myanmar. *Centella asiatica*, whose leaves are widely used as salad for lunch and dinner throughout Myanmar, is also used in Nagaland State. Hunting and gathering of small animals including rats, bats, flogs, lizards, flying squirrels, river fish and insects for food are also commonly practiced among the areas especially in mountainous and hilly forest places.

Fermented soybean called “*akni*” is produced and preferred in Nagaland, which is almost same as “pe-poke” or “pe-bouk”, a common product in various parts of Myanmar. Similar products were reported in Lao PDR, Thailand, Bhutan and Sikkim State of India (Nakao 1972; Nagai T & Tamang J P 2010). It also looks and smells very similar to “natto” in Japan, although it does not have so long threads trailing from it as natto.

We should consider what kind of agricultural basic complex has existed across those areas. Local people in Meghalaya and Nagaland kindly told us about the diverse landraces of rice and other cereals, pulses, and vegetables they grew particularly on the fields and on backyard gardens in the surveyed area. We interviewed villagers on what kinds of crops they grow, how they grow and how they use them. We saw agricultural products at marketplaces in both states, too. There is a clear difference between Meghalaya and Nagaland. Cultivated crops in Nagaland were rather similar to Kachin and Sagaing of Myanmar and to northern Lao PDR. Slash-and-burn cultivation is practiced in some places particularly on steeper mountainous areas in Nagaland, Kachin, Sagaing, northern Lao PDR and northern Thailand, which should be taken into consideration on the agricultural basic complex in the areas.

#### *Vernacular names of crops*

Crop names obtained with interviews to local farmers in the Northeast India and in Sagaing Region of Myanmar were summarized in Table 3. There are smaller variations of names obtained for rice, maize, soybean and banana in Meghalaya than in northern Lao PDR. Some photographs of crops that were not so familiar to the informants made confusions. On the contrary, they often tried to identify each of the 69 rice cultivars of the NIAS Global Rice Core Collection. Different cultivar names collected in rice and bananas in some locations suggest the importance of those crops in their agriculture.

Rice was called “khaw” at many places in Khasi area of Meghalaya, which implied similarity with Thailand, Lao PDR and Myanmar where “khao” is commonly used for rice or a rice variety, while “bahy” (or “bay”) is commonly used in Cambodia. Osada and Onishi (2010) compiled “Language Atlas of South Asia” and described that Khasi people in Meghalaya belonged to a group of Mon-Khmer sub-branch of Austroasiatic language family based on the study of Diffloth (2005).

Only two farmhouses closely located with each other were visited in Nagaland. One (2013WP041) grew vegetables in narrow and inclined fields. The farmers had very limited knowledge about the crops we showed with pictures and answered using Hindi words. They called rice “dhan”, which is popular in Nepal and also used in some parts of India, Bhutan and Pakistan. The informants at another place (2013WP042) were of Angami Naga people and told us different vernacular names from 2013WP041.

Almost Myanmar (Burmese) names were obtained inside Hkamti town and Shan people’s village inside Homalin township. On the other hand, names used in Naga villages in the mountains were unique and different from those used at Homalin and Hkamti towns or those in Nagaland of India. Because the number of observed places was limited both in Sagaing and Nagaland, further studies are needed.

#### *Future prospect of the traditional mountain agriculture in Northeast India and vicinity*

As mentioned above, the Northeast India, particularly Nagaland has common sets of traditional cultivated crops with mountainous areas of Myanmar including Sagaing Region and Kachin State and also those in Lao PDR. Drastic socio-economical change taking place in the areas will change their agriculture and indigenous landraces rather quickly. There still remains traditional crop species although they have introduced several “new” crops ravenously from outside. From the view point of agriculture basic complexes, early agriculture in hilly and mountainous areas of Northeast India and Southeast Asia might not be based on roots and tubers, but on some cereals such as upland rice and some millets together with rice bean, *Centella asiatica*, *Elsholtzia blanda*, *Zanthoxylum* sp., perilla, and so on. The field observation team concluded that minor crop varieties specific to those areas need to be studied as soon as possible. Particularly, it is highly needed to make field studies in scattered Naga villages in Sagaing Region of Myanmar.

#### **Acknowledgements**

The field observation were carried out as a part of a Grant-in-Aid Program for Overseas Academic Survey of Basic Research Type B (code No. 24405049, Program Leader: Makoto Kawase, National Institute of Agrobiological Sciences) authorized and financially supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan.

The members of the team express their sincere gratitude to Professor Dr. K. C. Bansal, National Bureau of Plant Genetic Resources, Indian Council of Agricultural Research, the Government of the Republic of India for discussing about possibility of exploration and future cooperative research on plant genetic resources and kind advice. They deeply appreciate all local people’s kindness, hospitality, and particularly telling us about their agricultural practices.

They express their cordial thanks to the Ministry of Agriculture and Irrigation, the Republic of the Union of Myanmar for various suggestions and helps, to all local people for their kind and warm hospitality. They are obliged to Mr. M. Nishigaki and his staff of Sanay Travel and Tours at Yangon and to all who assisted their field trips.

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# インド共和国北東部および隣接するミャンマー連邦共和国 ザガイン地方域北部における 栽培植物・有用植物の予備的観察

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## 和文摘要

本報は、2013年にインドのメガラヤ州、アッサム州、ナガランド州、ならびに2014年にミャンマーのザガイン地方域の地方市場と農家を対象に実施した現地観察記録の予備的報告である。これらの地域を対象に選んだのは、今までに現地調査を行ってきたミャンマー、ラオス、タイなどを含む東南アジアの丘陵および山間部の一部であり、東南アジアや南アジアの作物遺伝資源の多様性を考える上で調査が十分とはいえないためである。さらに作物遺伝資源を通じて地域の伝統的な農耕文化複合を理解することは、調査地点の選定や現地における農業生物多様性の保存戦略の策定にも有意義である。アッサム州、メガラヤ州およびザガイン地方域で訪れた市場ではウルチイネとモチイネの両者が売られていた。モチイネは東南アジアや東アジアに特異的であり、南アジアではめったに見ることができない。それらの市場ではダイコン、ブロッコリー、キャベツ、ニンジン、エンドウ、ナス、ショウガなどの世界中で見られる作物も一般的であった。それらに加えてさまざまな色のタケアズキ（ツルアズキ）、ツボクサ、*Elsholtzia blanda*（ナギナタコウジュの仲間）、サンショウの仲間、エゴマなどが相当量売られていた。さらにユカン、*Spondias cytherea*（ホグプラム）、ホーリーバジルなども散見された。いくつかの作物についてはインタビューを通じて作物の方名を記録したが多くの場合に地域ごとに異なり、また、東北インドでは北インドで広く使われているヒンディー語の単語とも異なっていた。ザガイン地域の大きな町ではミャンマーの他の都市と同様であるが、山村では全く異なる呼称で呼ばれていた。ツルアズキ、ナギナタコウジュ属の*Elsholtzia blanda*、サンショウ類、エゴマ、ダイズ等の発酵食品などの伝統的な利用はこれらの山地における農耕文化複合の共通性を暗示している。近代化は急速に進みつつあり、東北インドから東南アジア山地、とくにミャンマー・ザガイン地方域に点在するナガ族村落の伝統的な作物の調査を急ぐ必要がある。

Table 3. A summary of interviews on some traditional crops in the Northeast India and Sagaing State of Myanmar

		dd/mm/yyyy	04/02/2013	04/02/2013	04/02/2013	05/02/2013	05/02/2013	06/02/2013
		village	Lad Umroy	Mawkriah	Mawkriah	?	Maw Lyn Nong	Um Tham
		state	Meghalaya	Meghalaya	Meghalaya	Meghalaya	Meghalaya	Meghalaya
		map location (waypoint)	2013WP014	2013WP016	2013WP017	near 2013WP21	2013WP021	2013WP025
		latitude (N)	25°39'6.27"	25°43'17.77"	25°30'37.79"		25°13'26.57"	25°53'42.73"
		longitude (E)	91°53'46.34"	91°59'2.94"	91°47'9.81"		91°55'57.53"	91°53'36.16"
		altitude (m)	1103.47	885.73	1773.74		603.8	606.2
No.	crop name	Latin name						
1	rice	<i>Oryza sativa</i> L.	KHAW	KHAW cv. SINYAM	KHAW	not here	U KHAW	KHAW cv. KBALYANG KOT cv. JA SHULYA
2	maize	<i>Zea mays</i> L.	RIEW HA DAM	RIEW HA DEM	RIEW HA DEM	RIEW HA DEM	RIEW HA DEM	RIEW HA DEM
3	common wheat	<i>Triticum aestivum</i> (L.) THELL. ssp. <i>vulgare</i> (VILL.) MACKEY	no	wild (RADNYMLUNG)	wild (KEW)	no	no	no
4	durum wheat	<i>Triticum turgidum</i> (L.) Thell. ssp. <i>turgidum</i> conv. <i>durum</i> (Desf.) Mackey	no	no	no	no	no	no
5	barley	<i>Hordeum vulgare</i> L.	no	no	no	no	no	no
6	sorghum	<i>Sorghum bicolor</i> (L.) MOENCH	SOH RIW	no	RAI TRI / RAI SHAN	no	wild (RIEW P'NEI)	KU NIE THAN
7	pearl millet	<i>Pennisetum americanum</i> (L.) LEEKE	no	no	KRAIYNK HA	no	no	no
8	finger millet	<i>Eleusine coracana</i> (L.) GAERTN.	no	KRAI				
9	foxtail millet	<i>Setaria italica</i> (L.) P.BEAUV.	RAI SOH	no	no	no	no	no
10	barnyard millet	<i>Echinochloa</i> sp.	no	no	no	no	no	no
11	kodo millet	<i>Paspalum scrobiculatum</i> L.	no	no	no	no	no	no
12	yellow foxtail millet	<i>Setaria pumila</i> (Poir.) Roem. & Schult.	no	no	no	no	no	no
13	common millet	<i>Panicum miliaceum</i> L.	no	no	no	no	no	no
14	little millet	<i>Panicum sumatrense</i> ROTH ex ROEM. et SCHULT.	no	no	no	no	no	no
15	korne	<i>Brachiaria ramosa</i> (L.) Stapf.	no	no	no	no	no	no
16	soybean	<i>Glycine max</i> (L.) Merrill	RYM BAI	RYM BAI	RYM BAI	RYM BAI JA	RYM BAI JA	MOTOR
17	common bean	<i>Phaseolus vulgaris</i> L.	RI MANIPUR	(RYM BAI SAAW) not here	MANIPUR	no	RYN BAI	URIE PHRES BYN
18	mung bean	<i>Vigna radiata</i>	no	no	TUNG TOH	no		BI TILI MA
19	black gram	<i>Vigna mungo</i> (L.) Hepper	no	no	no	no	no	no
20	rice bean	<i>Vigna umbellata</i> (Thunb.) Ohwi & Ohashi	no	no	no	no	RYN BAI JA SHIM	no
21	winged bean	<i>Psophocarpus tetragonolobus</i> (L.) DC.	RIMAJAI	no	no	no	no	no



Table 3 (Continued).

		dd/mm/yyyy	04/02/2013	04/02/2013	04/02/2013	05/02/2013	05/02/2013	06/02/2013
		village	Lad Umroy	Mawkriah	Mawkriah	?	Maw Lyn Nong	Um Tham
		state	Meghalaya	Meghalaya	Meghalaya	Meghalaya	Meghalaya	Meghalaya
		map location (waypoint)	2013WP014	2013WP016	2013WP017	near 2013WP21	2013WP021	2013WP025
		latitude (N)	25°39'6.27"	25°43'17.77"	25°30'37.79"		25°13'26.57"	25°53'42.73"
		longitude (E)	91°53'46.34"	91°59'2.94"	91°47'9.81"		91°55'57.53"	91°53'36.16"
		altitude (m)	1103.47	885.73	1773.74		603.8	606.2
No.	crop name	Latin name						
22	cowpea/yard-long bean	<i>Vigna unguiculata</i> (L.) Walpers	BURI	PHRESBIN	PHRESBIN	PHRES BIN	PHRES BIN KHASI	
23	chickpea	<i>Cicer arietinum</i> L.	no	no	no	no	no	no
24	pigeon pea	<i>Cajanus cajan</i> (L.) Millsp.	no	no	no	no	TOH DENG	no
25	lablab bean	<i>Lablab purpureus</i> (L.) Sweet	RISAW	SHANAKVLAI	no	no	RIE	no
26	moth bean	<i>Vigna aconitifolia</i> (Jacq.) Marechal	no	no	no	no	no	no
27	sword bean	<i>Canavalia gladiata</i> (Jacq.) DC.	no	no	NA SHAIN	NA SHAIN	NEI SHIA	exists but no name obtained
28	buckwheat	<i>Fagopyrum esculentum</i> MOENCH.	no	no	no	no	no	no
29	guar	<i>Cyamopsis tetragonoloba</i> (L) Taub	no	no	no	no	no	no
30	amaranth	<i>Amaranthus cruentus</i> L.	no	no	no	no	no	no
31	amaranth	<i>Amaranthus caudatus</i> L.	no	PHRESBIN SAW	no	no	no	no
32	amaranth	<i>Amaranthus hypochondriacus</i> L.	no	no	no	no	no	no
33	sesame	<i>Sesamum indicum</i> L.	NEI YANG	no	NEI LEIH	no	no	NEI IONG
34	kenaf	<i>Hibiscus cannabinus</i> L.	BHANDI	no	no	no	no	MYSTA
35	rosselle	<i>Hibiscus sabdariffa</i> L.		no	no	no	no	MYSTA
36	bitter gourd	<i>Momordica charantia</i> L.	KARELA	SOH SHIA	no	no	KALERA	KALERA
37	snake gourd	<i>Trichosanthes anguina</i> L.	CHENKA	no	no	no	no	no
38	elephant foot yam	<i>Amorphophallus</i> sp.	SHREW (=taro)	no	SHREW	no	SHRIEW (=taro)	KSU ALU (=taro)
39	banana	<i>Musa</i> spp.	KAIT	no	no	KAIT cv. KAIT TYNGKA cv. KAIT WAI	KAIT cv. KAIT WAI cv. KAIT RIT cv. KAIT SYMPA cv. KAIT TYNGKA cv. SHYEING cv. MAT MAAN	KAIT
40	perilla	<i>Perilla frutescens</i> BRITT.	no	no	no	no	no	no
41	niger seed	<i>Guizotia abyssinica</i> (L. f.) Cass.	no	no	no	no	no	no
	note				Farmers mainly growing vegetables			

Table 3 (Continued).

		dd/mm/yyyy	06/02/2013	06/02/2013	06/02/2013	06/02/2013	09/02/2013	09/02/2013
		village	Um Tham	Kbet Mong Bri	Um Wang Them	←	Viswema	Viswema
		state	Meghalaya	Meghalaya	Meghalaya	Meghalaya	Nagaland	Nagaland
		map location (waypoint)	2013WP026	2013WP029	2013WP030	←	2013WP041	2013WP042
		latitude (N)	25°53'35"	25°54'1.3"	25°54'22.83"	←	25°34'19.9"	25°33'19.32"
		longitude (E)	91°54'20.7"	92°0'59"	91°55'52.72"	←	94°7'25.55"	94°8'22.12"
		altitude (m)	598.5	786	583.2	←	1611.8	1681.7
No.	crop name	Latin name						
1	rice	<i>Oryza sativa</i> L.	KHAW cv. JA PNA (sticky) cv. JA JOHAR cv. JA LYNGKOT cv. JA LYNGTER cv. JA KLEM (winter rice)	KHAW cv. JA MYRDEW cv. JA STEM cv. JA LALANG cv. JA LAHI cv. JA PNA (sticky) cv. JA DKHAR	KHAW cv. KHAW PNA cv. KHAW JOHA cv. KHAW KBA cv. KHAW SAW cv. KHAW LEIH cv. KHAW IONG	KHAW cv. KHAW JOHA cv. KHAW BARA cv. KHAW PNA (sticky) cv. KHAW SHOBOK cv. KHAW KUMBAL HALLI cv. KHAW SLA ER cv. KHAW LA KANG	not cultivated (DHAN)	YOKAHA cv. NUR HAS cv. RU LU cv. KEMENYO (half sticky) cv. HAR NYO cv. MU TSUE cv. NO KRE (sticky, big grain) cv. VAMUOZOHA (sticky)
2	maize	<i>Zea mays</i> L.	RIEW HA DEM	SOH RUUH	MI KHOR	MI KHOR	MAKKAI	ZAKOSHIE (sticky & non-sticky)
3	common wheat	<i>Triticum aestivum</i> (L.) THELL. ssp. <i>vulgare</i> (VILL.) MACKEY	no	no	no	no	no	no
4	durum wheat	<i>Triticum turgidum</i> (L.) Thell. ssp. <i>turgidum</i> conv. <i>durum</i> (Desf.) Mackey	no	no	no	no	no	no
5	barley	<i>Hordeum vulgare</i> L.	no	no	no	no	no	no
6	sorghum	<i>Sorghum bicolor</i> (L.) MOENCH	KU NIE THAN	T'DONG SIER	JAPH RAT	JA PHRAT cv. THENG THEH	no	TINEMISU
7	pearl millet	<i>Pennisetum americanum</i> (L.) LEEKE	should be in W Nepal	no	no	CHO YA	no	no
8	finger millet	<i>Eleusine coracana</i> (L.) GAERTN.	KUDU HOI introduced from Nepal		KHRAI	KODO		
9	foxtail millet	<i>Setaria italica</i> (L.) P.BEAUV.	no	no	JA IAH	no	no	O TSU (non-sticky & sticky)
10	barnyard millet	<i>Echinochloa</i> sp.	no	no	no	no	no	no
11	kodo millet	<i>Paspalum scrobiculatum</i> L.	no	wild (SOH BYRTHIT)	no	no	no	no
12	yellow foxtail millet	<i>Setaria pumila</i> (Poir.) Roem. & Schult.	no	no	no	wild (BAB)	no	no
13	common millet	<i>Panicum miliaceum</i> L.	no	no	no	wild (TIP LI LONG SO)	no	no
14	little millet	<i>Panicum sumatrense</i> ROTH ex ROEM. et SCHULT.	no	wild for fodder	no	wild (NONG THEH)	no	no
15	korne	<i>Brachiaria ramosa</i> (L.) Stapf.	no	no	no	wild (BAB)	no	no
16	soybean	<i>Glycine max</i> (L.) Merrill	RYN BAI	TUNG TOH	KA RYM BAI	RYN BAI		DALI (big grain & small grain)
17	common bean	<i>Phaseolus vulgaris</i> L.	no	TOH LA NEM	MANIUR	THAKE	SIM	U TISHIE
18	mung bean	<i>Vigna radiata</i>	no	PHRES BYN LUM	no	KAPI THAKE	NAGA DAL	HER SINNA
19	black gram	<i>Vigna mungo</i> (L.) Hepper	no	TUNG TOH	no	no	NAGA DAL	U TI
20	rice bean	<i>Vigna umbellata</i> (Thunb.) Ohwi & Ohashi	no	TOH JA	no	no	NAGA DAL	ER HER
21	winged bean	<i>Psophocarpus tetragonolobus</i> (L.) DC.	no	TOH	no	THAKE NO RE	no	CHAR KUNA



Table 3 (Continued).

	dd/mm/yyyy		06/02/2013	06/02/2013	06/02/2013	06/02/2013	09/02/2013	09/02/2013
	village		Um Tham	Kbet Mong Bri	Um Wang Them	←	Viswema	Viswema
	state		Meghalaya	Meghalaya	Meghalaya	Meghalaya	Nagaland	Nagaland
	map location (waypoint)		2013WP026	2013WP029	2013WP030	←	2013WP041	2013WP042
	latitude (N)		25°53'35"	25°54'1.3"	25°54'22.83"	←	25°34'19.9"	25°33'19.32"
	longitude (E)		91°54'20.7"	92°0'59"	91°55'52.72"	←	94°7'25.55"	94°8'22.12"
	altitude (m)		598.5	786	583.2	←	1611.8	1681.7
No.	crop name	Latin name						
22	cowpea/yard-long bean	<i>Vigna unguiculata</i> (L.) Walpers	TOH ONG	TOH JA		THAKE WER LO YE	MOTOR	BA TO
23	chickpea	<i>Cicer arietinum</i> L.	no	CHANA not indigenous	CHANA	CHANA BISIK	NAGA DAL	CHANA
24	pigeon pea	<i>Cajanus cajan</i> (L.) Millsp.	no	TOH LAHA	no	THEPA	no	U TI (beans)
25	lablab bean	<i>Lablab purpureus</i> (L.) Sweet	RIE two types	TOH RIE	THE PAH	THEPA WER	BATWAS	TU SOTI
26	moth bean	<i>Vigna aconitifolia</i> (Jacq.) Marechal	no	no	no	no	no	no
27	sword bean	<i>Canavalia gladiata</i> (Jacq.) DC.	no	TOH HEH	no	no	no	TI KI METO
28	buckwheat	<i>Fagopyrum esculentum</i> MOENCH.	no	no	no	no	no	no
29	guar	<i>Cyamopsis tetragonoloba</i> (L) Taub	no	no	no	no	(NAGA DAL)	no
30	amaranth	<i>Amaranthus cruentus</i> L.	no	SLA JHUR	no	DIDO KEIR	no	WA JU
31	amaranth	<i>Amaranthus caudatus</i> L.	no	SLA JHUR	no	DIDO KEIR	no	WA JU
32	amaranth	<i>Amaranthus hypochondriacus</i> L.	no	no	no	DIDO KILOH	no	WA JU
33	sesame	<i>Sesamum indicum</i> L.	NEI IONG	NEI IONG (black)	NEI IONG NEI LEIH	NEMPO (black) NEMPO SHALUK (white)	TIL (not grown)	WA KO
34	kenaf	<i>Hibiscus cannabinus</i> L.	MYSTA	no	JA JEIW	HAN SRONG KILOH	no	WA KO
35	rosselle	<i>Hibiscus sabdariffa</i> L.	MYSTA	JHUR SONG	JA JEIW	HAN SRONG	no	WA KO KOLI
36	bitter melon	<i>Momordica charantia</i> L.	KALERA	SOH THANG	KAROI	KAROI RONG KAROI (small)	KALERA	HA KELA
37	snake melon	<i>Trichosanthes anguina</i> L.	no	SOH PARU	BONG	NALAI GI	no	no
38	elephant foot yam	<i>Amorphophallus</i> sp.	SHREW (=taro)	SHREW (=taro)	HEN	HEN	MULA	no
39	banana	<i>Musa</i> spp.	KAIT cv. KAIT GIGI cv. KAIT WAR cv. KAIT SYIEM cv. KAIT SHYIENG cv. KAIT MON cv. KAIT MAN POH cv. KAIT KHPU	LADU cv. LADU JA cv. LADU SYIM cv. LADU GIGI cv. LADU SAMEN	KAIT cv. KAIT MYNDHOR cv. KAIT GIGI cv. KAIT S'YEIM cv. KAIT MON	PHUNGU cv. PHUNGU MUDRA cv. PHUNGU KACHA cv. PHUNG MULBHUG cv. PHUNG GI cv. PHUNGU MANDOR	KOL	O KU SHIE
40	perilla	<i>Perilla frutescens</i> BRITT.	no	NEI HA DEM	no	TEMPUH SHOLOK	exists but no name obtained	ON NA
41	niger seed	<i>Guizotia abyssinica</i> (L. f.) Cass.	no	no	no	AMIR	no	no
	note						female Hindostani worker at a farmhouse growing vegetables	Angami Naga

Table 3 (Continued).

		dd/mm/yyyy	03/02/2014	04/02/2014	05/02/2014	05/02/2014	07/02/2014
		village	AUNG THA	NOU TAROW	PASANG YWA	KYAO YWE YWA	HOMALIN
		state	Hkamti, Sagaing	Hkamti, Sagaing	Hkamti, Sagaing	Hkamti, Sagaing	Homalin, Sagaing
		map location (waypoint)	2014WP001	2014WP019	2014WP021	20014WP022	2014WP023
		latitude (N)	26°0'6"	26°9'1.21"	26°2'36.24"	26°0'6.83"	24°52'18.75"
		longitude (E)	95°41'29.34"	95°29'9.39"	95°33'33.69"	95°28'12.14"	94°53'56.99"
		altitude (m)	136	1196	1078	995	129
No.	crop name	Latin name					
1	rice	<i>Oryza sativa</i> L.	SABA	JO (non-waxy), ZAIHLEN (waxy)	CHUN-NYA	CHI-NYAK	KHAO, SABA
2	maize	<i>Zea mays</i> L.	SHAN PYAWN BU	BLAM	ZONG-NAM	BLAM	KHAO PA
3	common wheat	<i>Triticum aestivum</i> (L.) THELL. ssp. <i>vulgare</i> (VILL.) MACKAY	JAWN	no	no	no	GYONE (no here)
4	durum wheat	<i>Triticum turgidum</i> (L.) Thell. ssp. <i>turgidum</i> conv. <i>durum</i> (Desf.) Mackey	JAWN	no	no	no	no
5	barley	<i>Hordeum vulgare</i> L.	JAWN-SHI	no	no	no	no
6	sorghum	<i>Sorghum bicolor</i> (L.) MOENCH	HNANSAR PYAWN	CHIMBLAM	NALAM	MALAM	NANZA-PYAWNG
7	pearl millet	<i>Pennisetum americanum</i> (L.) LEEKE	HNANSAR PYAWN ?	no	PAI-JIN-NYAP	PAI-CHI-NYAP	no
8	finger millet	<i>Eleusine coracana</i> (L.) GAERTN.	they know	SOULIAM	UNGE-CHI-NYAP	UNGE-CHI-NYAP	no
9	foxtail millet	<i>Setaria italica</i> (L.) P.BEAUUV.	SAT (no here but in mountains)	SOULIAM	JIN-NYAP	JIN-NYAP	no
10	barnyard millet	<i>Echinochloa</i> sp.	no	MEHYAM ?	no	no	no
11	kodo millet	<i>Paspalum scrobiculatum</i> L.	no	no	no	no	no
12	yellow foxtail millet	<i>Setaria pumila</i> (Poir.) Roem. & Schult.	no	no	no	no	no
13	common millet	<i>Panicum miliaceum</i> L.	no (SABA? not sure)	no	IN-NYAP	IN-NYAP	no
14	little millet	<i>Panicum sumatrense</i> ROTH ex ROEM. et SCHULT.	no (SABA? not sure)	no	no	no	no
15	korne	<i>Brachiaria ramosa</i> (L.) Stapf.	no (PYAWN-SA)	no	no	no	no
16	soybean	<i>Glycine max</i> (L.) Merrill	PE-PAUK (no here but in mountains)	KAHU-THET	CHIU-TE	CHIU-TE	TU-BANAUK, PE-POUK
17	common bean	<i>Phaseolus vulgaris</i> L.	PE-SAR-OO	TOE-KASHU	YANG-LO	YANG-LO	PE-ZA-U
18	mung bean	<i>Vigna radiata</i>	MAPPE	no	TSUN-TSUO	TSUN-TSO	PE-THI-SEIN
19	black gram	<i>Vigna mungo</i> (L.) Hepper	PE-NGOE-TOTE	no	no (TSUN-TSUO)	no	TOE-SEIN (no here)
20	rice bean	<i>Vigna umbellata</i> (Thunb.) Ohwi & Ohashi	PE-TAUN-SHI, PE-LON-SHI	KASHU-LA, CHIN-PE	no (TSUM)	CHIN-PE, TSUM	OO-CHIN-LIN
21	winged bean	<i>Psophocarpus tetragonolobus</i> (L.) DC.	PE-ZAUNG-GAR	no	A-SAN-HE-LA-PON	A-SAN-HE-LA-PON	TOE-MA-PONG

Table 3 (Continued).

		dd/mm/yyyy	03/02/2014	04/02/2014	05/02/2014	05/02/2014	07/02/2014
		village	AUNG THA	NOUTAROW	PASANG YWA	KYAO YWE YWA	HOMALIN
		state	Hkamti, Sagaing	Hkamti, Sagaing	Hkamti, Sagaing	Hkamti, Sagaing	Homalin, Sagaing
		map location (waypoint)	2014WP001	2014WP019	2014WP021	20014WP022	2014WP023
		latitude (N)	26°0'6"	26°9'1.21"	26°2'36.24"	26°0'6.83"	24°52'18.75"
		longitude (E)	95°41'29.34"	95°29'9.39"	95°33'33.69"	95°28'12.14"	94°53'56.99"
		altitude (m)	136	1196	1078	995	129
No.	crop name	Latin name					
22	cowpea/yard-long bean	<i>Vigna unguiculata</i> (L.) Walpers	PE-LON-SHI	KASHU-KYAN	CHIU-NYAK	CHIU-KHIANG	PE-LONE-SI
23	chickpea	<i>Cicer arietinum</i> L.	KARA-BE	no	no	no	KALA-BE
24	pigeon pea	<i>Cajanus cajan</i> (L.) Millsp.	PE-SIN-NGON	no	no	no	PE-SEN-GONE (no here)
25	lablab bean	<i>Lablab purpureus</i> (L.) Sweet	NEW-PE (rare here)	no	LA-BON	LA-BON	MAUK-MA-KOH
26	moth bean	<i>Vigna aconitifolia</i> (Jacq.) Mairechal	no	no	no	no	no
27	sword bean	<i>Canavalia gladiata</i> (Jacq.) DC.	PE-DAMA	no	no	no	NI-TAUK-PE
28	buckwheat	<i>Fagopyrum esculentum</i> MOENCH.	no	no	no	no	no
29	guar	<i>Cyamopsis tetragonoloba</i> (L.) Taub	no	no	no	no	no
30	amaranth	<i>Amaranthus cruentus</i> L.	KYET MAUT (no here)	no	no	no	no
31	amaranth	<i>Amaranthus caudatus</i> L.	no	no	no	no	no
32	amaranth	<i>Amaranthus hypochondriacus</i> L.	no	no	no	no	no
33	sesame	<i>Sesamum indicum</i> L.	HNAN	NYAM-HAM	NYAM-HON	NYAM-HON	NGA
34	kenaf	<i>Hibiscus cannabinus</i> L.	CHIN BAUN (LAT CHAR)	no	no	no	CHIN-BAON-KHA
35	rosselle	<i>Hibiscus sabdariffa</i> L.	CHIN BAUN	CHIN-MAUN	GIEN-PON	GIEN-PON	CHIN-BAON
36	bitter gourd	<i>Momordica charantia</i> L.	KYITE HIN KHAR	MAKU-KHA	ZAN-TAI-NYU	ZAN-TAI-NYU	MAU-KON-KHAU
37	snake gourd	<i>Trichosanthes anguina</i> L.	BONE LONE	BONE-LONE-THI	KHON-LON-YIBU	KHON-LON-YIBU	MARAI-THAU
38	elephant foot yam	<i>Amorphophallus</i> sp.	no (PANEN-OO?)	no (PEIN-U?, DAUNG?)	KHON-ZAN-KE-U	KHON-ZAN-KE-U	no
39	banana	<i>Musa</i> spp.	NGAPYO-DI	LWEHAP	LU-SHIEP	LU-SHIEP, LU-HAP	MAKKOI
40	perilla	<i>Perilla frutescens</i> BRITT.	no (PIN SEIN ?)	NIAM	NIAM	NIAM	NGA-LOM
41	niger seed	<i>Guizotia abyssinica</i> (L. f.) Cass.	rare (PAN HNAN)	no	no	no	PAN-HNAN
	note				Khiamniugan Naga people	Khiamniugan Naga people	Tin Hnine Shan people



Photo 1. A shop in the marketplace of Dimapur, Nagaland State, India. Various fruits and vegetables including citrus, tamarind, siris fruits, bottle gourd, common beans, tree tomato, chili pepper, banana leaf sheath, ginger, shallot, eggplant, *Elsholtzia blanda*, *Brassica* sp, lablab bean, mushroom, and so on.



Photo 2. A slash-and-burn cultivation field in Sagaing Region of Myanmar. Rice had been cultivated there and already harvested. Sesame, roselle, maize were harvested and dried plants were stored in a hat.