PROCEEDINGS OF
THE TWELFTH AGRICULTURAL RESEARCH CONFERENCE
YEZIN AGRICULTURAL UNIVERSITY

17 January 2019

Nay Pyi Taw

Proceedings of the Twelfth Agricultural Research Conference
Yezin Agricultural University

Edited by

Nang Hseng Hom, Kyaw Ngwe and Aung Naing Oo

Published by:

Yezin Agricultural University

Nay Pyi Taw

Republic of the Union of Myanmar

Natural Resource Management under Climate Change Scenario: Case studies in Kanpetlet Township, Southern Chin State

Khin Lay Swe[1] and Kazuo Ando[2]

[1] *Retired Pro-Rector, YAU; Environmental Safeguard Consultant, Agricultural Development Support Project (ADSP), KRC and MOALI*

[2] *Professor, Department of Practice-oriented Area Studies, Center for South East Asian Studies (CSEAS) , Kyoto University*

Abstract

Myanmar has documented severely high rates of vitamin A and iron deficiency, and prevalence of anaemia and stunting children. These are the indicators of lack of diversity in food supply and high levels of malnutrition in Myanmar. Production diversity and dietary diversity in agriculture sector are important factors for improving nutrition and health of the people. Chin State is well known for its rich biodiversity and uniqueness of cultural and geographical features; and the Chin people traditionally maintained their local crop varieties in their Taungya farms. Two villages in Southern Chin State were thus selected as a study site to observe their unique practices of Taungya farming and natural resource management. Nat Ma Taung National Park, the highest mountain in Chin State, is situated within the Eastern Himalayas Endemic Bird Area. Mythuns are semi-domesticated livestock and highly valued by the Chin nationals. People practiced "Shifting Taungya" cultivation as the main livelihood over the past centuries. It was a sustainable land use system and also maintained the biodiversity with the sufficient long fallow periods. However, due to the land scarcity and population increase during last decades, farmers applied short fallow periods for their subsistence, creating severe deforestation and degradation. The Taungya lands became less productive, resulting fewer yields. Adverse climate change also affected the crop production and farmers have gradually abandoned their Shifting Taungya farming. The natural disasters, such as landslides and erosions were on a risein recent years. Chin State has the largest sown areas of local maize varieties in Myanmar. Farmers generally grow maize, millets, Job's tears, taro, turmeric and etc. As a traditional staple food, people used to consume "maize-meal", a mixture of maize with rice or millets. With good export markets, the elephant foot yam cultivation started in 2010. The southern Chin State produces the highest quality of the yam and farmers are expanding its areas. With more income from the yam production and other job opportunities, people shifted to consume rice as a staple food these days.

Keywords: Taungya farming, elephant foot yam, local maize varieties, Mythums

1. Introduction

Chin State lies in the north-western mountainous region of Myanmar and is well recognized for its uniqueness in culture and geographical features. The Chin Hills are home to the temperate and alpine species typical of the Himalaya Mountain Range. The Mount Victoria (NatmaTaung in local language) is the highest mountain in Chin State and one of the most widely distributed pines in Asia. The flora and fauna of Mount Victoria is extremely rich, with seven types of forests ranging from *Dipterocarp* forest at the bottom to oak and pine forest at the top of the mountain. It is an Important Bird Area (IBA), which lies within the Eastern Himalayas Endemic Bird Area. To protect its rich biodiversity, Natma Taung National Park (NTNP) was established in 1994. It was also designated as an ASEAN Heritage Park, listed as an Alliance for Zero Extinction Site, because of the White-browed Nuthatch (*Sittavictoriae*), an endemic species to this area.Over the past centuries, the Chin nationals mainly relied on shifting / swidden cultivation, collection of non-timber forest products and hunting for their livelihoods. By applying traditional Shifting Taungya farming with sufficient fallow periods, people well sustained their forests and natural resources. They traditionally owned their lands by customary laws, which partly encouraged the land conservation. However, with increasing land scarcity, infrastructure development and population growth during last decades, farmers practiced short fallow periods for their subsistence. As a consequence, severe deforestation and land degradation are prevalent in Chin State these days. In addition, many medicinal orchids and other endemic plant species have been extracted from the NTNP, and exported to China. It has reached a critical state in which precious native orchid biodiversity within the NMNP might be lost (JICA, 2013).

Given its topography and poor transportation, Chin State had a poor economy and poor infrastructure. According to a household survey, Chin State was identified as the poorest State of Myanmar both in terms of poverty (material possessions) and food poverty (nutrition, foodsecurity). It also represented a highest poverty rate (73.3%) and a high infant mortality rate of the country (IHLCA, 2011).

2. Methodology

Several field study visits were conducted at Par Kun and Saw Laung villages, Kant Thar Yone Village Tract in Kanpalet Township during 2015 and 2018. Focus Group Discussions (FGD) were organized to obtain basic information about their livelihoods, culture and the status of native crops. It was focused on their natural resource management practices in the context of food security, nutrition and income generation. The existing crops and production of elephant foot yam in study villages were recorded. The photos of site visits and FGD were also documented.

Moreover, the secondary data were collected from the relevant government departments, such as Department of Agriculture (DOA), General Administration Department (GAD), Livestock Breeding and Veterinary Department (LVBD) and etc., in Kanpetlet Township. This research document will serve as a base line study for the future rural development programs to strengthen farmers' ability to conserve their natural resources, food security in the context of climate change.

3. Research findings

3.1 Climate change and disaster impacts in Chin State

Kanpatlat Township has a hot and warm climate and the maximum temperature is 36 ºC and the minimum is 4 ºC (GAD, 2017). The climate related hazards and extreme weather events are one of the main environmental issues Myanmar is currently facing. The country has often experienced with seasonal floods and landslides in several parts of the country. During the last decades, human settlements have been increasing together with rapid tourism industry development and population growthin Chin State. Concurrently, the climate related disasters (earthquakes, floods and landslides) were on a rise. The most devastating landslide in Myanmar was recorded in Chin State in July 2015 due to the impact of Cyclone Koman. The total rainy days were 26 with a total rainfall of 1,151 mm recorded in Kanpetlet Township in July 2015 (Table 1). Heavy rains caused landslides and earthquakes across the Chin State. Over 20,000 people were displaced and more than 3800 houses were destroyed; roads and bridges were seriously disrupted. Low land rice fields were also destroyed. Again in monsoon seasons of 2016 and 2017, landslides and flooding after a week of heavy rains significant damaged the infrastructures and crop lands in hilly areas of Chin State. Farmers noticed the warmer climates during the previous years and that their agriculture productions were significantly affected.

Furthermore, the rodent outbreaks seriously affected the crop production of Chin State during 2007 – 2009. It was believed that bamboos in the forests flowered about 50 year- intervals before the plants die. During the bamboo seed shedding, the high availability of food enhanced the breeding performance of rats; and rat population increased within a short time. When the bamboo seedlings were growing in the forest, food was not sufficient for the high rat's populations and they migrated into agricultural fields in search of food. Many farmers lost between 50 and 100 % of their upland crops (rice and maize) due to the destruction of the swarms of

rodents. It left thousands of people facing food shortages and even starvation — nearly 10,000 people required emergency food aid. It was recorded that during 2007 rodent outbreak, 1,227 ha, representing 6,749 people faced a food shortage. In 2008, 5,286 ha of rice in 105 villages and 260 ha of maize in 16 villages were destroyed while 99 ha of 51 villages were attacked by rodents in 2009 (Htwe et al., 2010). Furthermore, farmers who did not experience rodent infestation had a reduced harvest because of severe weather conditions and drought (FAO, 2009).

Table 1. Weather data (monthly rainfall and rainy days) of Kanpetlet Township in five successive years (2012 – 2016)

Month	2012		2013		2014		2015		2016	
	Rainy days	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days	Rainfall (mm)
Jan.	0	-	0	-	0	-	2	14.0	0	-
Feb.	0	-	0	-	2	26.9	0	-	0	-
Mar.	1	34.5	0	-	0	-	1	7.1	0	-
April	4	87.6	1	30.7	4	15.7	5	21.1	0	-
May	6	118.4	18	231.4	8	72.9	14	229.9	12	167.9
June	20	238.0	17	296.2	20	419.1	18	143.0	21	306.8
July	13	146.8	21	360.2	11	88.6	26	1,151.1	16	183.1
Aug.	18	395.5	25	422.4	17	204.7	22	248.2	23	605.5
Sept.	18	420.9	21	655.1	13	168.1	18	287.5	14	318.3
Oct.	15	288.0	20	334.3	11	137.4	13	160.3	13	263.4
Nov.	0	-	0	-	4	64.0	3	56.6	7	137.2
Dec.	0	-	0	-	0	-	1	10.4	0	-
Total	**95**	**1,730**	**123**	**2,330**	**90**	**1,198**	**123**	**2,329**	**106**	**1,982**

Source: DOA Kanpetlet Township, Southern Chin State

3.2 Homestead gardens and shifting Taungya system

The cultivated lands in Kanpetlet Township were 373 hafor low land, 291 ha for orchard/ homestead garden and 2,225 ha of Taungya lands, and the reserved forests were 103,332 ha (DOA, 2016). In general, all households have homestead gardens or orchard (locally called U-yin) of about one – two acres. It is also known as Taungya farm (Permanent Taungya) where they traditionally grow maize, millets, pulses, fruits and vegetables at a subsistent level. Shifting Taungya was

widely practiced as a traditional livelihood over the past centuries. It is a sustainable land use system when the fallow periods are long enough (more than 15-20 years) for the soil fertility enrichment and secondary growth of the forest. Compared to permanent/ conventional farming, it sustains more biodiversity and protects the land from erosion and degradation. The designation of NMTP and other Reserved Forest areas, and consequent law enforcements began around 2000. Consequently, Shifting Taungya lands were strictly controlled and restricted. Due to the land scarcity together with population increase, Taungya farmers reduced their fallow periods for their subsistent living, creating a very high rate of deforestation and soil erosion. As a result, the lands showed no longer productive. The situation was compounded by the adverse impact of climate change, producing very fewer yields. Young people had less interest in farming and migrated for a better living. Furthermore, the extension of Kanpetlet Town and tourism development were undertaken in 2000s and villagers were employed in construction sites. The daily labor wages were higher than the income of farming. With these background conditions, farmers gradually abandoned Shifting Taungya farming and many people became employed with wage-earners.

3.3 Maize and millets as traditional diets of Chin State

Myanmar maize farmers need about 5,000-6,000 metric tons of maize seeds annually to meet the domestic demand. An estimated 90 % of farmers used hybrid and improved varieties distributed mostly by Charoen Pokphand Group (CP) of Thailand and some by Department of Agricultural Research (DAR). The unique characteristic of Chin State was that it has the largest sown area for local maize varieties in Myanmar. In 2012-13, maize total sown area in Chin State was 22,671 ha, of which local varieties comprised of 81 %. It was noted that maize farmers in Kanpetlet Township used only local maize varieties. Two types of maize were common in study villages: sticky (mostly white) / fresh maize which was consumed baked or boiled; and non-sticky (white and yellow one) cooked as a "Maize meal". Chin people traditionally consumed "Maize-meal", as a staple food over the past twenty years. For making it, the dried seeds were soaked in water for some time. The moist seeds were de-husked by pounding with a wooden mortar (called "Suum" in Chin language) to get different sizes; they were crushed again into small pieces against a stone slab. They were sorted into different sizes – the big pieces were firstly cook, then middle sized ones added, and lastly the small ones added to get a harmoniously cooked staple dish. Maize is mainly composed of carbohydrates, and has small amounts of protein and fat. Whole-grain maize is as healthy as any cereal grain, rich in fiber and many vitamins, minerals, and antioxidants.

Millets (Finger millet (Sat Ni in local language) and Foxtail millet (Sat War)), pigeon pea, rice bean, black gram were widely grown in Shifting Taungya farms. As a traditional meal, only maize was cooked or it was very often mixed with Sat War and cooked. Sat War is tastier for a meal or snack while Sat Ni is used to make fermented local brew/ wine ("Khaung" in local language). Millets are cultivated in high elevations. The ingredients and health benefits of millets are a good source of fibre and carbohydrates and can help control blood-sugar levels and reduce risk of heart attacks. For Chin people, the protein sources are local chicken, pork, Mythun beef and eggs. The wild animals like field rodents, frogs, snakes, and jackrabbits are also eaten. Besides the "Maize- meal", a "Maize soup" is a well known traditional snack or a light meal in Chin State. It is called "A-dwe" in Chin language in Southern Chin State while in Northern Chin State it is known as "Sa-bu-dee". A-dwee is eaten with beans and vegetables while "Sa-bu-dee" is usually mixed with meat (pig, Mythum, etc.). It is usually prepared at home and consumed in summer season and in some occasions such as meeting with friends and relatives, some harvest time, and etc. A-dwe soup is available at some restaurants at Kanpalet and Mindat. These days, rice is easily accessible due to the good transportation and people have more income to buy rice from elephant foot yam production and daily labor wages. As a consequence, the consumption habit of "Maize –meal" has been gradually disappeared. The photo documentations of findings of the site study visits to Par Kun village and Saw Laung villages were presented in Appendix 1 and Appendix 2.

3.4 Natural setting of the study villages

There are 44 households with the population of 294 in Par Kun village while 30 households and 187 population in Saw Laung village in 2016. Generally, all farmers have abandoned Shifting Taungya farming. People owned their Taungya lands by their customary laws and some privately owned the lands. They collect timber and fuel wood in a sustainable way, protecting the soil erosion such that they never cut the trees of slopping areas and river banks. There are quadrant or circular belts of forests about half a mile away from the periphery of the villages, keeping them a safe distance from the possible spreading forest fire. A foot path, as well as for a fire-break, was built by burning of bushes and grasses about two meters width around the village. It was called a "charredroad" ("Sui-tuk"in Chin language and "MeetarLan" in Myanmar language). People well maintained their communal forest between the village and Taungya lands. The forests around the study villages are generally protected from the collection of fuel or timber wood.

In Chin villages, the unique local knowledge and technologies for their sustainable livelihoods are still well preserved. Most villages were surrounded by communal forests and their Taungya farms were generally situated far from the

villages, protect from catching fire by Taungya burning. Big trees were seen conserved around the springs as well as on the slopes for protecting water sources and soil erosion. One unique feature was that when farmers cut the trees for land clearing of their Shifting Taungya, they usually left the tree stumps of about two meter high above the ground. They believed that it is easier for re-growth of the trees as well as for the protection of soil erosion.

The study villages were characterized by subsistence farming. Many kinds of edible crops, shrubs and trees (about 15 – 20) were sown together, but in small number of each, in their homestead or Taungyar lands. Major food crops were categorized into grains, pulses, roots and vegetables. Grains comprise millets, maize and Job's tears while pulses include black gram, cow pea, rice bean, pigeon pea, and sulphur bean. It was seen that some pulses plants were climbing on the tree stumps in some places, and in the other places they were twining on maize plants. Root crops were taro, sweet potato, arrow root, turmeric and ginger. Vegetables include pumpkins, cucumber, chillies, egg plant, spinach and etc. A variety of large and small fruit trees like avocado, coffee, tea, banana, sugarcane and pineapple were also cultivated. They were largely diversified providing the various nutrients and diets to the local people's daily consumption.

These local crop varieties, especially maize, millets and pulses have significant local importance- a potential source of vitamins, micronutrients and high nutritional value. They also contribute household food and nutrition security, health and income generation. Taro is very common food as a meal in this area. *Perilla* (locally known as Chin Hnan/ Shan Hnan) is an oil- seed crop, people usually eat with rice or maize as a supplementary meal. It was seen that the wild species of Job's tears, finger millets, banana, *Vigna spp.*, *Ana spp.*, and *Canna spp.* and etc., were naturally grown along the village roads and homestead of study villages.

Chin State is an area of continuation of Bhutan and Arunachal Pradesh where Mythuns (*Bosfrontalis*) are commonly found. Mythuns are well bred in some Chin villages and they are locally called as Nwar-nauk. They are semi-domesticated livestock and raised in free range system, roaming around in shifting Taungya lands and forests. Mythun feast is the most important festival for the spirit worshipping and the meat is also served in wedding ceremonies. For the festivity, people slaughter Mythun according to their financial capacity and serve the villagers. The number of Mythuns and other livestock in Kanpetlet Township was described in Table (2). It was noted that the number of Mythuns is much larger than that of cow and buffalo. The meat of Mythun is a popular dish available at the local restaurants of Chin State.

Table 2. Livestock data of Kanpelet Township

Year	Buffalo	Cow	Pig	Chicken	Goat	Mythun
2012-13	827	671	3863	14656	2127	4168
2013-14	912	307	4947	17695	na	4447

Source: Kanpetlet Township Livestock Breeding and Veterinary Department, 2014

3.5 Elephant foot yam production in Chin State

There are 28 Village Tracts and 124 villages in Kanpatlet Township. The northern most part is cooler than other areas and is suitable for maize and millets while the southern part is favorable for paddy cultivation. Low land (Le) areas were 373 ha of which 186.6 ha were cultivated with improved rice varieties in 2018 -19. Rice area was reducing partly due to the destruction of Cyclone Komen in 2015 and partly by the encroachment of elephant foot yam. Elephant foot yam (*Amorphophallus campanulatus*) is locally known as Wa-u or Phyan-uwhichhas been growing naturally in Taungya lands and forests since long time ago. People considered them as weed plants and the corms were fed to the pigs. The yam business began around 2010 in Chin State; people collected the corms from their Taungya farms and nearby forest for sale. Due to its good price, farmers started to grow it in their homestead areas, Taungya farms and any other available places. In Kanpetlet Township, the yam area was increasing from 38 ha in 2009-10 to 295.4 ha in 2018-19 cropping season. Due to the area extension of the yam, the areas of upland / Taungya crops were largely decreased, such as Taungya rice, maize, millets and pulses (Table 3).

Table 3. Crops sown areas in Kanpelet Township

Crops	Annual sown area (ha)				
	2009-10	2013-14	2016-17	2017-18	2018-19
Low land Rice	280	268.7	228.2	170.0	186.6
Taungya Rice (Upland)	2,597	1293.0	1172.8	946.2	947.0
Maize	2,188	1138	918.7	864.4	866.0
Other cereals (millet)	887	359	322.1	291.4	293.0
Pulses	1157	624	382.4	322.9	287.3
Elephant foot yam	38	109	170.0	275.2	295.4

Source: DOA, Kanpetlet Township, Southern Chin State

For the elephant foot yam production of Chin State in 2017-18, the largest sown area were found in Mindat and Matupi Townships with 1,107 ha and 1,114 ha, respectively. The yields varied from 1.15 t/ha in Tunzang Township to 13.21 t/ha in Paletwa Township. Total sown area of Chin State was 3371 ha, producing 14,386 tons in 2017-18 (Table 4).

Although the elephant foot yam grows well in several states and regions of Myanmar, it was said that Kanpetlet and Mindat Townships produce the highest quality corm. China, Thailand and Japan are buyers of dried elephant foot yam and the official statistics showed that Myanmar's export of dried elephant foot yams has earned over US$2.5 million in fiscal year 2016-2017. It contains "Glucomannan", which is often used as an anti-obesity treatment. Purple yam flesh contains significant levels of the antioxidant anthocyanin, which gives this yam great potential as a medical crop.

Table 4. Elephant foot yam production in Chin State in 2017-2018 cropping season

No.	Districts / Townships	2017-2018			
		Sown area (ha)	Harvest area (ha)	Yield (t /ha)	Total production (ton)
Hakha District					
1	Hakha	68.8	49.6	4.63	232.45
2	Thantlang	257.2	257.2	4.63	1205.30
Falan District					
3	Falam	71.6	59.6	5.64	340.16
4	Tedim	348.0	156.0	3.87	610.27
5	Tunzang	22.0	22.0	1.15	255.09
Mindat District					
6	Kanpetlet	272.0	144.0	4.89	712.96
7	Mindat	1107.2	1080.4	4.11	4491.34
8	Matupi	1114.4	542.8	11.40	6262.73
9	Paletwa	110.0	106.0	13.21	275.79
Total in Chin State		**3,371.2**			**14,386.09**

Source: DOA Office, Kanpetlet Township, 2018

Generally, all households in study villages grew elephant foot yam ranging from one acre to five acres, while five farmers are cultivating between 5 and 25 acres. The yam production is a great opportunity to improve the local economy and it also creates a good income opportunity to manual laborers and landless people. However, due to the high cost for plantation, farmers cannot extend its area. Some farmers took loans for investment of this crop but they were at high risks of unpredictable market price. The State Government and/ local organizations should assist farmers for their sustainable and successful production.

It was clearly found that people are still maintaining their traditional food crops in their homestead and Taungya lands in a subsistence level. At the same time, they are changing their Shifting Taungya to a permanent semi-commercial farming system, mainly with a commercial production elephant foot yam. Since it is

a root/ digging crop grown in slope areas, soil erosion can easily occur if the protection measures are not taken. Therefore, agriculture extension services are urgent needs for the sustainable crop production in mountainous areas like the Chin State.

3.6 Food insecurity and malnutrition in Myanmar

Recent research documented that Myanmar has severely high rates of vitamin A and iron deficiency and the prevalence of anaemia among under five year's old children and women. High proportions of stunting children under five years old were also recorded. In addition, food insecurity and malnutrition are major challenges in many rural and remote areas of the country, including the Chin State. These are the indicators of lack of diversity in food supply and high levels of malnutrition in the country. Due to its extensive agro-biodiversity, Myanmar has a huge potential for addressing malnutrition. For improving nutrition and health of the people, the strategies of production diversity and dietary diversity in agriculture sector should be undertaken in an urgent manner. To accomplish this, agriculture sector should consider an inclusion of "nutrition-sensitive agriculture" and creating an enabling environment of producing more nutritious food. As an example, there are several local / indigenous crops in Chin State such as maize, millets, elephant foot yam which can be identified as promising crops to address the malnutrition problem.

4. Conclusion

The research findings showed that the Taungya crops are an integral part of subsistence farming in study villages of southern Chin State. They are well adapted to their particular ecological regions and play an important role in providing community with their daily nutrients. Therefore, future detailed studies of these crops should be carried out. Scoping the availability, prioritizing and identifying local varieties with high potential and mapping the selected species will be an important base line study for further rural development programs. For example, varietal improvement of local maize and millet varieties and improved growing techniques should be prioritized in the development program. Developing of quality protein maize (QPM) varieties should be included in the national breeding programs. The trainings and supports should be provided for the proper agriculture practices since the farmers are currently changing their Shifting Taungya to permanent faming system. The wild plants and native plant species are valuable natural resources which need to conserve properly for the future use of crop improvement programs in home country and abroad. Some of them can possibly be used to produce value added export items of nutritious and medicinal purpose.

Presently, the National Community-Driven Development Project (NCDDP) and other Regional projects have been implementing in Kanpetlet Township. Under these projects, the infrastructure development will soon be much improved in Chin State, most importantly; the roads will be more easily accessible. Along with this, the existing natural resources will be endangered more seriously than before. Therefore, the inventory and conservation of these valuable wild plant species are urgently necessary before they are lost forever. Proper management strategies and law enforcement are key factors for the conservation and sustainable use of these natural resources.

5. References

Ando, A., Y. Akamatsu and K.L. Swe. 2017. Learning about locally existing technologies by Rapid Rural Appraisal in the villages, Kanpalet Township, Chin State, Myanmar. J. Agrofor. Environ., 11(1&2)107-113.

ATWGARD, 2015. Promotion of Climate Resilience in Rice and Maize, Myanmar National Study, ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD) and the Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ) GmbH through the ASEAN-German Programme on Response to Climate Change (GAP-CC).

CCERR, 2015. The Chin State Floods & Landslides: A community-led response and assessment. Chin Committee for Emergency Response and Rehabilitation (CCERR). 3rd December 2015. themimu.info/sites/ themimu.info/files/ assess mentfile/CCERRpublicationEng.pdf

Dupertuis Noémi-Tiina, 2017. Livelihood problems and cultural adaptation in a southern Chin village under recent economic change in Myanmar. Centre for Southeast Asian Studies of Kyoto University (CSEAS), Japan. Feb., 2017

FAO, 2009. FAO/FFP. Crop and food security assessment mission to Myanmar. Rome. FAO and World Food Programme.43 p.

FAO, 2017. FAO aims to make Myanmar farming climate-change proof. Myanmar Times. Aye Sapay Phyu 31 OCT 2017. https://www.mmtimes.com/news/ fao-aims-make-myanmar-farming-climate-change-proof.html

FAO, 2017. Workshop Report. FAO Regional Initiative on Zero Hunger Challenge Regional Inception Workshop for Regional TCP on Creating Enabling Environments for Nutrition-Sensitive Food and Agriculture to Address Malnutrition, In collaboration with ICARDA and ICRISAT. 30 March 2017. www.fao.org/fileadmin/templates/rap/files/meetings/2017/170330_Report.pdf

GNLM, 2017. Landslides, flooding hits hilly areas in Chin State, Date: 23 Sep 2017. Posted by Global New Light of Myanmar (GNLM). http://www. globalnewlightofmyanmar.com/landslides-flooding-hits-hilly-areas-in-chin-state/blished on 23 Sep 2017

GNLM, 2017. Export of dried elephant foot yams earns nearly US$3 million. Global New Light of Myanmar, Date: September 19, 2017; http://www.globalnewlightofmyanmar.com/export-dried-elephant-foot-yams-earns-nearly-us3-million/

GRET, 2012. Study on the Chin State, prepared by U San Thein, senior consultant, farming systems agronomist. August 2012

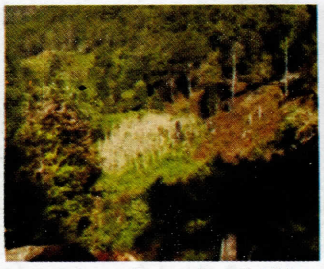
Htwe, Nyo Me et. al., 2010. Rodent outbreaks: Ecology and impacts. International Rice Research Institute (IRRI)

IHLCA, 2011. Integrated Household Living Conditions Survey 2009-10 Myanmar: Poverty profile. Yangon: United Nations Development Programme (UNDP, Myanmar).

JICA, 2013. Project Report. "Education and training of Myanmar personnel for the realization of phyto diversity conservation and sustainable use of plant resources to improve economy of the rural population". December 2013. The Koehl Prefectural Makino Memorial Foundation. Inc. Japan International Cooperation Agency, Shikoku Branch Office, Japan.

Appendix 1. Photo documentation of site visits at Par Kun village

1(a) Land preparation at Taungya fields



1(b) Maize plants in shifting Taungya (after harvest)

1(c) Storage of maize cobs and pumpkin fruits

1 (d) Fox tail Millets (Sat War) storage in a bottle gourd

1 (e) A pot of local brew (Khaung) made of Finger millet (Sat Ni)

1 (h) A Chin woman with a motor for breaking maize seeds

1(f) Millet powder, broken maize seeds and maize meal

1(g)) Broken maize seeds, A-dwe, maize soup, a common local diet of Chin State

1 (i) A Shifting Taungya field: millets, maize, pulses, Hibiscus plants

1 (j) Women participants in Par Kun village FGD

1 (k) Shifting Taungya fields seen from Par Kun village's Primary School

Appendix 2. Photo documentation and site visit at Saw Laung village

2(a) Job's tears plants at Homestead garden in Saw Laung village

2 (b) A homestead of various food crops - finger millets, taro, banana and etc.

2 (c) Finger millets at a homestead garden in Saw Laung village

2(d) A couple going for hunting, and collection of Non Timber Forest Products

2 (e) A Nwar-Nauk and its calf seen near a village of Kanpetlet Township

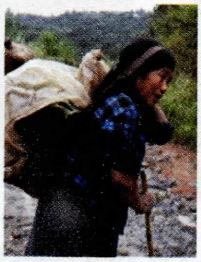
2 (f) A new road access to Saw Laung village

2(e) elephant foot yam(near harvest)and local maize (after harvest)in a Taungya farm

2(f) Harvest time of elephant foot yam at a steep roadside

2 (g) Collection of elephant foot yam seeds (bubbils) from the branches

2(h) Harvest time of elephant foot yam, labourers carrying the corms



2(i) A Chin lady carring a basket of elephant foot yam, 30 Oct., 2019

2(j) ShweTaung Tan Farm, a whole sale center at Kanpetlet Town