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Chapter 5

Indigenous Technologies and Local Climate Change Adaptation Practices around East Kawlchaw Watershed, Saiha, Mizoram: A Case Study

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INTRODUCTION

The technologies that are employed by the native inhabitants in a region which forms an important part of its culture and heritage may be called as indigenous technologies. These technologies are drawn from the indigenous knowledge that is unique to a given culture or society and are basis for local-level decision making in agriculture, health care, food preparation, natural resource management and other activities in rural communities (Warren 1991). These technologies are basically intended to enhance the ability to maintain & renew balance and harmony within a multidimensional environment (Waas *et al.,* 2011; Oxfam 2011). Although indigenous peoples' traditional ways of living have very little to contribute to climate change, they are most adversely affected by the climate change (Henriken 2007). The characteristic features of the indigenous livelihoods are low carbon, heavy dependence on local biological diversity and ecosystem services for sustenance of wellbeing (Cox 1999). Since climate change brings degradation to forests, loss of biodiversity and other resource stock and services on which the marginal/rural communities depend, the consequence of climate change may drastically impact local livelihood (Scoones 1998). There are several case studies which have shown that indigenous practices help marginal farmers cope up with the climatic changes (Malesu *et al.,* 2006; Dey and Sarkar 2011; Kibassa 2013; Dinesh and Vermeuleu 2016; Patrick 2018). Indigenous responses to climate variations typically involve changes to livelihood practices and other socio-economic adjustments (Nirmal Kumar 2010; Ford *et al.,* 2011) and therefore strengthening of traditional knowledge on resource management should be given top priority (Sherpa *et al.,* 2013). Nevertheless indigenous knowledge may provide valuable insight into the direct and indirect impacts, as well as mitigation and adaptation approaches (Berkey *et al.,* 2000; Ajani *et al.,* 2013).

The North-Eastern States of India (NEI) in general and Mizoram in particular are very backward in terms of infrastructure development, agricultural production and diversified livelihood options. Compared to the mainland India, the land-man ratio in the region is more than double (0.66 ha) while its cultivable area is only 15% to the national average (59%) to the geographical area (Ngachan *et al.,* 2014). Among the NEI states, Mizoram

possibly has the most difficult terrain limiting the cultivation of agricultural crops; scarcity of water further limits the scope for multiple cropping. Thus shifting cultivation becomes the most dominant form of agriculture widely practiced in the state which is highly subsistence in nature. Among all the districts, Saiha is the most backward district of Mizoram as per the Planning Commission of India's index of backwardness; based on agricultural productivity per worker, agricultural wage rate, SC/ ST population under the National Food for Work (NFW) Programme (Ngachan et al. 2014). The people of this district are more prone to the vagaries of nature as they have inadequate access to appropriate technologies and other external inputs and are exposed to increased natural calamities, characterized by fragile landscape.

The objective of the study was to identify and document various indigenous technologies, local knowledge and practices that are imbodied related to natural resource management in and around East Kalchaw Watershed, Saiha as mean of livelihood, protection measures, and also to understand how these practices are integrated in climate change adaption.

MATERIALS AND METHODS

The study was conducted at East Kawlchaw Watershed measuring about 500 ha area comprising three villages namely E. Kawlchaw, Maubawk and Theiva involving 250 households. These villages were formed into a cluster village for carrying out various interventions on self-help group mode under National Agricultural Innovation Project. During the bench mark survey, Participatory Rural Appraisal exercise was conducted to collect various household information and resource mapping. The beneficiaries were divided into small group of 4-5 members who prepared resource maps, resource sketches and their location, matrix ranking on different resources available to them, suggested various solutions to the problem they faced, provided details how the resources are being utilized by them and what are the vagaries of nature that they are experiencing now. To supplement to these claims, household interviews were also conducted using both closed and open ended questionnaires containing various socio-economic attributes, livelihood and adaptation related issues. Besides, transect walk was performed to verify and observe various practices in the field and recorded. The people's knowledge about biodiversity, historical land use and various conservation measures that were integrated with modern science and technology as mean of natural resource management, were all recorded and documented.

RESULTS AND DISCUSSION

Indigenous Drinking Water Collection

Drinking water is a very scarce resource in the hill regions. For this and other household needs, the hill men usually depend on seepage water obtained at different hill slopes. The usual method consists of preparing a small ground for water tank or digging a hole on a sedimentary rock where water oozes naturally through the soil layers. The name of this prepare water tank/reservoir is called "Tuikhur". The village people believe that water from this Tuikhur is very safe for health. However, scientific understanding is that the water coming through the different layers gets sieved and becomes free from different debris and large insoluble particles. As water is not exposed to surface temperature, it is cooler. This practice is common to all the village people. The village people sometimes collect seepage water for drinking purpose. A permanent seepage water course is locally "Tuihna" which are typically located in the rocky slopes. A bamboo such as *Dendrocalamus hamiltoni, Melocana baccifera* is split open and placed on the source of water to carry water from the seepage. Bamboo carrier may be in natural cylindrical or splitter form. The splitter bamboo is locally called "Tuidawn". Generally, bamboo is hollowed to use as a pipe by removing partition at nodes and connected to each other until the desired length is got. If the bamboo carrier crosses ground depressions bamboo or wood probes are used as support. Sometime a cross pole is placed to raise the Tuidawn, so that people can drink water while standing. This is a unique example of drinking water collection using indigenous techniques in the hilly areas. The access to the water is open to all and a tired traveler can have cool natural water from these places. By tradition, the Lushai people construct their dwelling

huts at the hill top. However as the village people resides at the hill top they have to fetch water from a water tank/ reservoir locally called Tuikhur for different household purposes. Female members and often the children are engaged in fetching water. They fetch water as often as they need but approximately 2 to 3 times per day is common. One adult female carries 4 to 5 bamboo containers made of *Drendrocalamus hamiltoni* amounting to about 5 to 6 litters of water. The water is mostly used for drinking and cooking purposes. All these cylindrical bamboo containers are bound together and placed in a bamboo basket locally called "Paikawng (Em)". This Paikawng is carried on the back by a band attached to the forehead. Another common practice of carrying water is with the shell of gourd. When the gourd is ripening they cut the top portion and clean the inner side. It is then use for carrying water. Water remains cool in these containers because the gourd shell acts as an insulator.

Indigenous Water Conservation and Storage

Water plays an important role in cropping in the hill region. Water conservation therefore is very crucial for crop production. In Mizoram, rain fall are usually characterized by medium to steep slope of tertiary hills which induced runoff and therefore farmers, employ various techniques to hold water for farming and other income generating activities. In the state very little fishy culture has been practiced in some village. The farmers used an improvised technique to maintain the desired water level in the reservoir and drain out excess water by placing a rubber/bamboo pipe of about 2" diameters at a desired level in the embankment (Fig. 1). The integrated of livestock with fish is yet another good practice to adapt to climate change in the area (Sahoo and Singh, 2015). The systems besides being resilient to climate change have been additionally profit making. The indigenous way of putting banana shoots and leaves on the water not only help the water to get cool but also provide better living condition for growth of the fish. The growing of Colocasia around bund of the water bodies is believed to control the snails. The farmer blocks the pipe outlet with a wooden pin to conserve water especially during season. When the farmer needs irrigation in the lower agriculture field or for other purposes, the wooden pin is removed. This indigenous technique enhances the efficiency of water usage and maintains water availability round the years. In Jharkhand, bamboo drips or small springs structures are created to store water in rainy season to be utilized for irrigating winter crops (Das and Sarkar, 2011).

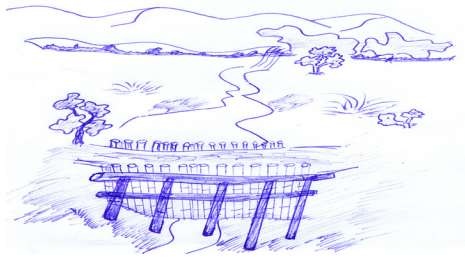

Fig. 1: Water Conservation by Putting Bamboo Stakes

An indigenous engineering structure locally called "Tuikhuah" is an indigenous dam where earth, bamboo and wood are used for it construction. Generally the dam is built on a small natural stream creating an upstream reservoir. The core structure of the dam is earthen whose size depends upon the size of the stream and intended a mount of water to be held. The dam is provided with additional support structures. Usually bamboo or wooden posts are pegged in to the ground along the dam and wooden/bamboo crossbars are placed to protect it. Within a few days of rain, the water level in the reservoir rises to 5-6 feet in height. Thus it becomes suitable for fish culture, irrigation and other household activities.

Indigenous Farming Technology for Soil and Water Conservation

Terrace Cropping

In the hill region, the local people employ a special method to cultivate which can be termed as "Terracing". The farmers dig out terrace in the slopes of the land (Fig. 2). Mostly terrace are used for growing cash crops like pine apple and other fruits trees such as papaya, banana, sweet potato, chilies, brinjal and other vegetables. Fruits trees and fuel trees are also planted on the edges of terrace to strengthen it. The farmers usually plant 2 rows of pineapple in the terrace and at the edge of the terrace

banana, soybean, subabul and *Gmelina arborea* are planted. It has been found by observation in the hill tracts that trees species and fruit trees together perform well silvi-culturally. There are other types of terraces constructed for raising fodder crops with fruits trees by the farmers. Mainly leguminous trees are grown on the outer edge of the terrace. They prevent soil erosion and supply biomass for the cattle. They also improve soil fertility. Biomass is also used for mulching. Various types of mulches have proved found to enhance the yield of tuber crops in the area Fruits trees grown in the terrace are guava, pineapple and lemon etc. this types of terrace cropping are prevalent in the valley and widely practiced by the farmers.

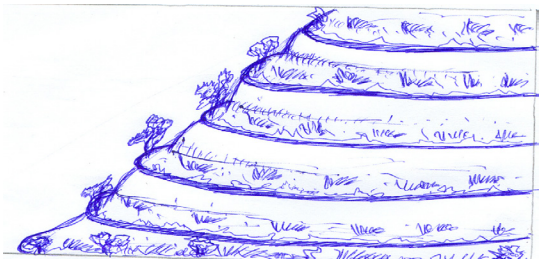

Fig. 2: Terrace Cultivation Practiced under the Hill Slope

Contour Cultivation on Terraces

This system is practiced on a large scale for soil and water conservation. It has the capacity to retard runoff, increase infiltration of rainfall and conserve soil and water. This contour model was introduced in the farmer's field and is showing promising results (Fig. 3). The contour lines were demarcated clearly. The nitrogen fixing trees such as subabul, pigeon pea and non-nitrogen fixing species are planted at closer to spacing to established hedges. This farming system protects the land from degradation and keeps the land protective on sustained basis (Pachuau et al., 2012).

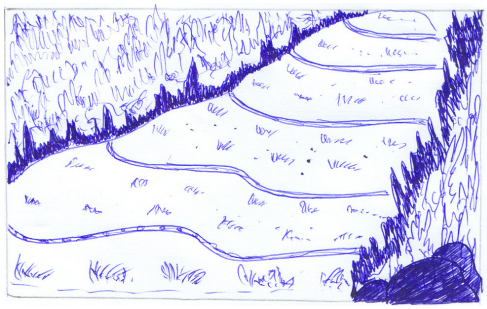

Fig. 3: Contour Trench Farming System as Practiced by the Tribals

Minimum Tillage and Mulching Technique

Minimum tillage and mulching system has the advantages in reducing soil erosion, organic matter and increasing crops yield. In this technique the farmland is not ploughed after harvesting the previous crop. Ditches are excavated in rows with a fixed spacing for broadcasting. The crop residues between ditches are retained and previous crop straw, leaves or green manure are used as mulch to cover the newly planted crop. Farmer in the hill people used a number of indigenous mulch materials. The most widely used mulching materials comprises of leaves, twigs, banana leaves and stem fibers, legumes etc. Farmers often raise hedgerow along the contour to obtain adequate supply of mulch materials and to promote soil and water conservation. The purpose of mulching is to retain soil moisture so that the plant can take up the necessary nutrients. Mulching is particularly important in the hill regions as water tends to travel downward faster in case where the hills are not adequately covered by vegetation (Sahoo, 2008). A wide variety of mulches such as rice straw, subabul leaves and green mulches are practiced in the area to increase moisture conservation on hilly terrain. These mulches are nevertheless available in plenty locally and are not competitive, in the sense there is no other use for these products in the area. Rice straw is hardly used as thatch even for livestock and therefore this could be best used as mulch in the site. The effects gained are the same as in complete mulching except that the mulching is confined to the base of the plant owing to the shortage of labour and mulch (Pachuau et al., 2012). By this practice direct impact of the raindrops on bare soil is prevented, moisture in the rhizosphere is retained. Weeds ground the trunk are suppressed and labour cost for weeding is reduced (Vanlalhriatpuia et al., 2012). The methods also helps to regulate soil temperature and to increase soil organic matter whereby improving the physical, chemical and biological properties of the soil. However, the mulch used could possible serve as habitat for pest and

diseases. Some grasses species applied as mulch can root and create a weed problems.

Waste Logs and use of Bamboo in Soil Erosion

Waste logs and use of bamboo in soil erosion control are practiced in the farmer's field to prevent soil erosion and runoff on hill slopes (Fig. 4). Logs of trees which otherwise would have remained unutilized are laid down on the farmer field horizontally. When it rains, waste logs act as mechanical barrier to erosion. This is practiced by farmer on the onset of rain. This practice is particularly useful where logs of minor value are available. This method seems crude and its effectiveness has not been measured on field research. Thus there is need for further investigation.

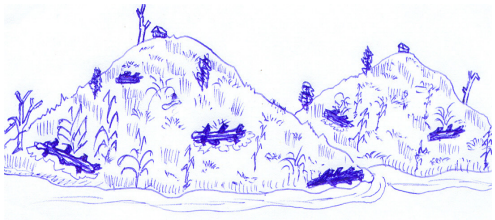

Fig. 4: Waste Logs for Soil Conservation in Agricultural Fields

Banana Soil Conservation and Faster Ripening Method

Banana has been found planted in all the villages with the aim of earning some cash benefits to the households. Besides, the local people do this with the belief that they are very stable and can withstand all sorts of natural disasters (Fig. 5). When the banana fruits are mature, they plucked with a doe (Chem). Plucked banana are put inside a parcel/ basket on a large of rice straw and some tree leaves particularly Albizzia species in a container. Also one top and sides of the fruit, the amalgam of Albizzia leaves or Rice straw is evenly placed. The container is closed for a few days. In this method, Albizzia/ rice straw is applied as a heating agent which help to ripen banana faster. Therefore, the farmers can sell the ripe bananas at the local market earlier and earn higher price. Furthermore, the fruits have even colour and good appearance in response used of Albizzia leaves or rice straw. This practice is very common and no chemical treatment is applied. It is environmentally health. However, if bananas are left in the container longer, the fruits could be burnt or rot due to excessive heat.

Fig. 5: Banana Plantation for Soil Conservation

Banana is a good sources of cash, it root system is quiet extensive and they hold big chunks of soil. The broad big leaves dissipates a lots of monsoon rain drop kinetic energy. Thus rain drops can not hit the soil directly. Therefore, splash erosion hazards are greatly reduced. However, the farmers not being aware of these facts, practice this out of their cultural beliefs. The banana thus planted yield good result in new sites but as the other species grow, they become suppressed and their productivity is reduced. Further research should be conducted to solve this problem.

Indigenous Agronomic and Cultural Practices

Shifting Cultivation

The main occupation of the Mizo's people is Jhum cultivation. It is practiced in every village. The chief and the elders were the proper custodians of the village land. Each year, the chief and the elders had a committee to decide upon the method of distribution of Jhum land for the year's cultivation. No other part of the village land other than the agreed ranges or stretches of land should be cleared for the year's cultivation by any family. The elder had the privilege of the first choice within in the agreed ranges. They were, thus, called "Zalen" (free men). The elders were the chief's councilors and the chief might ask them at any time, of their help even to the extent of incurring economic expenses.

They did share the glory and the success of the chief. Next to the Zalen came, "Ramhuals" who were few individuals, the chief's favourites, selected by him had the second choice of Jhum land. As the Ramhuals had to pay double the regular usual amount of paddy tax, the chief might select as many Ramhuals as he pleased. Ramhuals might be selected from near the relatives of the chief or elders or they might be locally influential families on whom the chief could depend for help at all time. After the Zalens and Ramhuals satisfied themselves with their plots, the ranges were then publicly open for the year's Jhum cultivation. Each household head would select plot for his family and would be demarcated it from the others by a small streams or other natural or artificial dividing lines etc. as the hill men were familiar with the village territory, boundary lines might also be simply expressed in words. In early January, the clearing of jungles was started. The clearing of jungles has been men's job as the work consisted of clearing dense and rough jungles. After clearing, the plot was left to dry up to be burnt in late March or early April, closely followed by the first round of weeding work. After burning, seedling was started. The seedling work was largely left to the women folks while the building of Jhum shack was men's work. In the month of May, the seedling work was over followed by the first shoot of weeds, and then the real agricultural work began. Rice was the principal food of the Mizo's. But other crops like maize, sesame, soybean, mustards and a variety of vegetables were grown purely for domestic consumption. The steepness of the ranges rendered terrace cultivation impossible and the mode of production has to follow, and is still following, the primitive system of Jhum cultivation. As such, the level of production had to remain very low. However, Jhum cultivation had provided the ethos necessary for the villagers to experience the feeling if oneness resulting from the common bond derived from the sharing of the village land in a uniform way. The practice of Jhum cultivation did not permit permanent land holding system, and this reinforced the sentimental attachment to the Jhum land which materialized itself in the affectionate adaptation to the whole village territory resulting in the solidarity of the villages. The cycle of Jhum cultivation was usually seven to eight years. Thus, the whole village land was connected with agricultural sentimentalism because many cycles would take place in one's life time. It, therefore, appeared that the solidarity of the village was the effect of the system of agricultural work and agricultural land.

No Tillage Practice

Generally, the Mara people practiced no-tillage system in which the farmers used simple implements easy to handle such as dribbling stick and animal horn in the past. Recently a hoe locally called "Tuthlawh/ Chemkawm" is used to plant agriculture crops. From the point of view of soil conservation no tillage system are most desirable. Most of the Mara people practice a dribbling method for planting crops like rice, maize, cotton, chilies, cucumber, pumpkin, soybean and other vegetables on the hill slope. No tillage or dribbling method involves making small holes by using a hand held special type of soil worker locally Tuthlawh/ Chemkawm. The farmer then put seeds of different crops mixed in sack which is hung on a sling around their shoulder or waist of the woman folk who accomplish this task. The seeds is covered with soil and then left for the nature. The farmers start seedling before onset of rainy season. They usually hold the belief that maize seedling on Good Friday yield a good crop variety and good quality as well. When seedling is done the farmers always move along the contour for their conveniences, saving time and energy and limiting erosion. The use of this technique insures a minimal soil loss in the rainy season. Besides, there is no need to depend upon complicated implements which have to be imported. Tillage is not necessary, thus poor farmers can easily adopt it.

Home Garden

A home garden locally called "Chuktuah huan" is an important traditional agroforestry system which is practice in every village (Jeeceelee and Sahoo, 2015). A home garden is an assemblage of plants which may includes trees, shrubs, bamboo and herbaceous plant in or adjacent to a home or home compound. These are intended primarily for household consumption and there is close association of woody perennial crops and invariably lives stock within the compound of the individual house with the whole crop animal unit

being managed by family labour (Fig. 6). Chilies, mustard, banana, papaya, mango, plum, jack fruit, pineapple and some other domesticated wild fruit and vegetables are commonly planted in home garden (Barbhuiya et al, 2016; Rocky and Sahoo, 2018). Fodder and fuel trees are also planted for home consumption throughout the year. Flower for ornamental and an aesthetic purpose are also observed in most home garden. The size of the home garden is varied. Many villages have comparatively small home plots providing vegetables and fruit for home consumption (Sahoo, 2009). The magnitudes of its economic and cultural importance and environmental significance had also varied from one place to another. In some place nearby the market, the production from home gardens contributes a relatively large portion of the household's income, whereas in remote areas with poor access to the market, the people practice system almost solely for domestic consumption, for cultural rites and for ecological stability (Sahoo et al., 2011). Generally, the cost of production in home garden is relatively low. Unlike other agricultural practices, it can be tended at any available time without needing the peak time for labour. The home gardens provide not only food but also fuel wood, fodder and shade at the same time. It also contributes to a certain portion of household economy by selling some products (Barbhuiya et al. 2016). A combination of different foliage renders the soil rich with litter fall and root turnover. The attention paid to home gardens is however very limited. Management is often poor. The farmer's knowledge of nitrogen fixing perennials is often limited and significant homegarden improvement is needed in most cases. Mango is one of the most important horti-crop which is very prominent in the East Kawlchaw Paradise Valley where farmers invariably grow various tuber crops such as ginger, turmeric, vegetables like French bean, roselle, cowpea and horti crops like pine apple, guajava under this tree to maximize the utilization of land and increase crop productivity and income generation (Sahoo, 2016). Besides, these systems have been able to improve the soil health compared to mono-crooping. The homegardens and mango-based farming has been very effectively helping the farmers to adapt to climate change and obtain regular yield across seasons and have less risk against climatic vagaries.

Fig. 6: Home Garden as Practiced by the Tribes

Mixed Cropping

Mixed cropping is practiced in every village in the farmer field. It is a system in which more than one crop is cultivated on the same piece of land (Fig. 7). It merit to b considered as a soil conservation and fertility management practice. Main crop of upland rice is mixed with rice, chilies, brinjal, soybean, turmeric, ginger, cucumber, pumpkin and other vegetables. The mixture pattern is very randomly. The upland rice has a growth cycle of around 140-160 days depending on elevation. In some village, maize is mixed with bean and other vegetables. In the mixed cropping of maize and rice beans, maize stem serve as a live support for rice bean as it is a climber and can grow upon the maize straws. As rice bean spreads rapidly, the soil is conserved weeds aggression is limited. Legumes can improve the soil through biological nitrogen fixation so that the companion corn plants may benefit from it. However, mixed cropping without soil improvers such as nitrogen fixing species may end up with an acute deficiency of soil nitrogen, one of the most limiting nutrients is such a low-input agriculture. Intercropping of maize and French bean, turmeric and roselle have been found have provided better crop yield and higher land equivalent ratio than mono-cropping (Sahoo et al., 2015). The mixed cropping too has resulted in better forage yield and quality.

Fig. 7: Mixed Cropping in Agricultural Land Use

Natural Fertilizers

The farmer practiced natural fertilizers in their agriculture field and home garden. They depend on natural fertilizers with no or low chemical fertilizers supplement for their crop production. Cow dung discharged materials from livestock breeding including swine and poultry excreta are commonly used in agriculture field as natural fertilizers. However the quantity and kind of natural fertilizers used vary according to their availability. In general natural fertilizers are brought in to the field, spread out and thoroughly tilted to mix evenly with the soil. Then crop are cultivated. Farmers' thus reduces the use for chemical fertilizers and save money. However, natural fertilizers do not fully meet the nutritional requirement of the crop in terms. The practice is labour-intensive and sometimes enhances weed problems. Nutritive value of the natural fertilizers is not known to so how much more fertilizers should be added remains unanswered. Even if it is known, to get the required amount at the right time is uncertain.

Indigenous Hill Agriculture

Site Identification by Applying Indigenous Knowledge

As the Mara people almost entirely depend on hill slope agriculture, their prime concern therefore is the correct site condition. To identify sites conditions the communities employ a numbers of indigenous methods. This particularly practice is related to the stability of the hill slope. Where the tribal people find that a particular hill slope contains a Gibbon's/ Monkey skull (Zawng Luruhro), a Tree stump (Thinglubul), and some red portion (Leiruangtuam) on the ground, they do not crop that site. If the site is free from these, they practice agriculture. Thus the tribal people employ an indigenous technology to identify which site should be left alone and should practice agriculture crops.

Bamboo as Site Indication

Bamboo has been used as a good site indicator by the people in the hill forest through generations. In their search for an appropriate site of agriculture, they usually select a site which is covered by natural bamboo. The people also believed those bamboo covered sites are better sites for agriculture practice. This idea has been validated by observation. Bamboo conserves soil against erosion, bamboo creates a large shade under its foliage. This reduces the evaporation thus more soil moisture is retained. As more soil moisture exists under and around bamboo groves, a congenial atmospheric is created for microbial activities. Thus these sites become better site. Besides, as the nomadic people shift from one place to another, they have to build dwelling huts in the sites. Bamboo supplies ready made raw materials, which are easy to collect and useful to prepare different implements. This is also a fact that the people find it easier to clear linear bamboo stems rather than clearing broad leafed sturdy tree species with their manual implements.

Ash as Soils Improving

The Mara people in the Paradise Valley have been traditionally used for ash for improving soil fertility in shifting agriculture practice (Fig. 8). The usual method of shifting cultivation is preceded by clearing the jungle with fire. The ash is retained on the soil. This is usually done in the month of April, at the onset of rain and during the initial rain it gets mixed with the soil. Ash mixture in the soil helps create humus especially clay humus complex provided that clay content is high. This increases nutrient and water holding capacity of the soils which in turn expedites soil chemical processes especially under the open Sun. Thus the overall soil structures improve.

Fig. 8: Ash Application as Insect Repellant in the Field

Indigenous Insect-pest Management

Ash as Minimize Insect and Pathogen Attack

Ash is used by the people to reduce insect and other pathogen attack on the crop (Fig. 8). The farmers broadcast as on the plant of gourd, pumpkin, brinjal, cucumber when insect and other pathogen attack is detected. Ash supposedly has insecticidal or insect-repellant properties. Some nutrients from ash may be available for plants. However, there is no systematic study on effectiveness of the use of ash. Thus the short term and longer term impact of this practice are unknown. The ratio of soil and ash mixture is also unknown. Only a thumb rule suggests that about 2.5-5 cm thick layer of ash is retained. The people also apply ash around the mango orchard as a mean to reduce pest problem and reduce mill bug infections. The studies have shown that the farmers in Jharkhand use a mixture of Kerosine oil, burnt disels and Karanja oil for successfully controlling various weeds in the crop fields (Dey and Sarkar, 2011). Waterlogging was used in places where there had been severe termite problem in the farmers' plots.

Indigenous Forest Management Practice

Forest Safeguard by Tribal Community and Spiritual Belief

In some places, the tribal community strictly prohibited burning, encroaching, agriculture practice and hunting. If some one is found guilty, punishment is severe. But nobody has tried to violate the prohibited acts so far. They raise a variety of useful trees and plant around their home stead. These trees at the same time contribute significantly to water shed management. Generally, the prohibited land is located around the homestead which is maintained as a mixed community forest consisting of fruits, forest and multipurpose trees. These lands are not devoted to the traditional hill agricultures. The tribal community usually extracts the mature trees and utilized those household purposes. The system can be roughly termed as selective felling. This practice causes least deterioration to the soil. Thus, this indigenous selective felling system seems to have watershed management. Belief can also play a fundamental role in maintaining the forest and their environment. Many people believe that super natural beings can either hark or benefit their daily life. Destruction of trees and forested areas where super natural beings presumably dwells is regarded as wrong doing by villagers for their spiritual well being. Thus, this belief safeguards trees and forest to a great extent. Likewise, the graveyard is regarded as the place where all the ominous are present. Consequently, tree groves in the cemetery sites secluded from the access by people out of fear.

Bamboo Forest Management

Bamboo occupied an important portion in shaping the livelihood, culture and religion among the people. Bamboo is widely used in constructing dwelling huts, household and agricultural implements, food, worshipping, watershed management and a host of other uses. It is amazing that one single species can effectively meet such a wide variety of tribal needs. Bamboo culms grow naturally as pure stands or as an under storey of tropical evergreen species. *Melocana baccifera, Bambusa tulda, Dendrocalamus hamiltoni, D.hookeri, D. longisphathus* etc. are grown abundantly on the hilly areas. The hill people irrespective of any tribes have evolved their own silvicultural system of sustainable managing the bamboo forest. The hill people do not cut the bamboo and trees during rainy season. They believe that bamboo and trees cut in the rains will be infected with insects and diseases and will loose their worth. This is true because most of the pathogens find rains as a congenial period to attack and breed. However, this practice has got other significance in terms of watershed management. The growth period of bamboo and trees is during the rainy season. They grow vertically in the rainy season. Cutting them in the rain would affect their growth but most importantly the site will be exposed and will be vulnerable to erosion. This practice has contributed a lot to minimize soil erosion. The bamboo and trees are therefore cut during the winter, from October to February where there is no rain bamboo are rated high in the soil moisture conservation, soil and water conservation and gully control.

Indigenous Tools and Equipment

Dao (Chem)

A Doe local people called Chem is used for a lots purposes such as to clear the bushes and jungles for Jhum cultivation, dibbling seeds in the soil, to cut bamboo posts preparing bamboo wall and roof materials and weapons against wild animals by the tribal peoples (Fig. 9). It has got one sharp edge sharpen with a file by the blacksmith but the other side is too blunt. The blunt side can be used as hammer in driving pegs in the ground. The local people further sharpen it after procuring from the blacksmith in the same direction as the blacksmith did. The local people generally used a hard stone for sharpening.

Hoe (Tuthlawh)

A hoe locally called Tuthlawh is a light weight tool, easy to handle and is mostly used by the tribal people for farm activities like weeding, clearing, seedling, etc (Fig. 9). The blade is made of old steel plate and is concave in nature. The outer face of the blade is about 6 cm and the width decreases near the butt. It han handle made of wood about 30 cm in length. The length of the blade near the butt to the tip is about 10 cm. The tool is widely used by all the tribal people of the hill tracts.

Chemkawm

Chemkawm is also a light weight tool. Easy to handle. Usually, women members use this tool for seedling, weeding and clearing agricultural field. It has got a concave shaped/ comma shaped Iron blade fitted in to a wooden handle (Fig. 9). The Iron blade is about 4-6 cm in width. The handle of wood is about 15cm in length. Sharpening is done on one face of the blade. This tool needs special skill to use.

Sickle (Favah)

Harvesting sickle local people called Favah is a tool used for crop harvesting operations. It has got one sharp edge with very fine serrated teeth (Fig. 9). The sharpening is done on one face of the blade. The Iron blade is about 4 cm in width. Favah is used for cutting the rice ears, clearing weeding and collecting thatching materials.

Spud (Tuthulh)

A spud locally called Tuthulh is an indigenous equiptment used by the local people to collect wild under ground tuberous crops. The tool has a long handle made of wood or bamboo an iron blade (Fig. 9). The width of the cutting face of the blade increases towards the end and reaches 4-5 cm. This is used in making holes in the ground tom drive posts for home constructions raising fences. Holes can be made on the ground to a greater depth with this tool but soil disturbances can be kept at a minimum level. This is particularly useful to make holes in the slope. It's long wooden/ bamboo handle about 90 cm enables one to work while standing which is another advantages of using this tool.

Axe (Hreipui)

An Axe Local people called Hripui is a tool which is often used for household purposes rather than the agricultural operations in the field but for fuel wood collection, felling a trees or to prepare chips for fuel wood (Fig. 9). Usually the local people used two kinds of axes. One has got a bent cutting wedge which is used to cut small size trees and the other has a straight cutting wedge useful to felling big trees. Both of these cutting wedges are made of Iron and handle about 40-60 cm in length are made of wood or bamboo. The cutting blade is about 15-20 cm in length and 6-8 cm in width. The wedge is thicker nearer the butt.

Indigenous Spiritual Faith and Belief Related to Jhum Cultivation

The life of Mizo's in the past was greatly influenced by superstitions or by their belief in superstitions. Their whole life depended on "Thiang' (fortune) and 'Thianglo' (misfortune). They believe in unusual occurrence as portending some evil results. To do certain things and to kill certain animals is very bad and unlucky. Certain acts, dreams or sights are universally considered as thianglo (misfortune). If they see any unusual sight or hear an unusual sound they believe to happen some misfortune. Superstitions control all the activities of the native peoples. They believe in superstitions has been connected with their daily life and their traditional Jhum cultivation. It is very unlucky to

find a gibbon's skull stuck on a tree stump or even on the field and a 'Thinglubul'(tree stump) on the site of their proposed Jhum land, death will certainly claim the Jhummias should he persist in Jhumming anywhere near the unlucky object. If the Jhummias dreams of a mithun chasing him or tigers springing on him after his first day's work of cultivation he must not continue and must stop the cutting jungle otherwise he will certainly get ill probably will die. If in burning the Jhum flames make a 'huk' 'huk' sound, it is better to abandon the Jhum.

CONCLUSION

The various indigenous technologies that are in practice in E. Kawlchaw, are products of a long history of creative adaptation to local environments. These adaptive practices have helped these people to live well and with confidence in diverse and sometimes harsh environments, as well as develop their livelihoods. However, many of these indigenous practices are being vanishing over the years due to various reasons. It is therefore most important that the government's land use policies should amalgate indigenous farmers' practices into the modern practice, so that they are no mismatch and conflict on the resource use pattern in rural communities for the marginalized people.

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