Intervention of LDPE Rainwater Harvesting Structure - *Jalkund* and HDPE Water Harvesting Structure for Jhum improvement in Nagaland

[1*]P. Chowdhury, [2]K.L. Meena and [3]D.J. Rajkhowa

[1]Subject Matter Specialist, KVK, Longleng, [2]Programme Coordinator, KVK, Longleng
[3]Joint Director, ICAR Research Complex for NEH Region, Jharnapani

[*]Corresponding author's email: pulakabha@yahoo.com

Introduction

Longleng District is located between longitude 94°E - 95°E and latitude 26°N - 27°N of the equator. Longleng District has a total area of 885 Sq. Km. The district can be divided into three regions topographically, namely; Chingmei Range in the northern part, Shemong Range in the middle part and Yingnyu Range in the southern part. Longleng district have one state and 3(three) district boundaries. On the east it shares boundary with Tuensang and Mon district of Nagaland. On north it has Nagaland's Inter-state boundary with Assam. On the west it shares boundary with Mokokchung District of Nagaland. On the South it shares boundary with Tuensang district of Nagaland. The altitude of the District varies from 150m to 2000m above the sea level. Longleng Town, the head quarter is around 1100m above sea level. The principle rivers that flow through Longleng district include Dikhu and Yongmon. The population of Longleng District is entirely Schedule Tribe. The main inhabitants are from the Phom Tribe of Nagas. As per 2011 census, the total population is 50,593 and the literacy rate of the district as is 44.82%, of which 57% are Male and 43% are Female.

Soil

District soils are mainly, red loamy and brown forest soil or sub mountain soil, residual soil/ lateritic soil and alluvial soil. The characteristics of the soils are depicted in the Table 1.

Table 1 Soil types and their characteristics

Sl. No	Soil type	Characteristics
1	Red loamy & brown forest soil or sub mountain soil	Soil brown in colour, acidic in nature, pH ranges from 4.3 – 6.5
2	Residual soil/ lateritic soil	Acidic in nature, and highly affected by soil erosion
3	Alluvial soil	Highly fertile soil, suitable for cultivation of all crops.

Climate

Longleng enjoys monsoon type of climate with a minimum temperature ranges from 3-11°C in winter and a maximum ranges from 19-30°C in summer. The district has a fairly

moderate climate where days are warm and nights are cool. Rainy season sets in during the 1st week of June and lasts till September. From October to March, the District has dry weather relatively cool and days are bright and sunny. The average rainfall is 2000mm with rainy days 132day and annual relative humidity (RH) ranges from 50 to 85%. The onset of monsoon and mean weather data of Longleng are here below in the Table 2.

Table 2 Onset of Monsoon and Mean Weather data of Longleng District

Rainfall	**Normal RF(mm)**	**Normal Rainy days (number)**	**Normal Onset**	**Normal Cessation**	**Temperature (^{0}C)**		**Relative Humidity (%)**
					Max	Min	
Pre-monsoon/ Summer (Mar – May)	434.36	92.33	-	-			
South West Monsoon (June-Sep)	1245.98	157.33	1st week of June	4th week of Sept.			
Post monsoon (Oct – Dec)	266.30	37.00	1st week of Oct	4th week of Nov			
Winter (Jan- Feb)	35.81	2.55	-	-			
Annual	**2020.36**	**132.00**	**-**	**-**	**19-30**	**3-11**	**50-85**

Flora and Fauna

Longleng District is rich in natural vegetation. It enjoys the distinction of being one of the few places in Nagaland where virgin forests are still found. Sub-Tropical Mixed Forest characterized by broad-leafed evergreen trees and deciduous trees abounds. The main/dominating species in the high altitude are such as Bonsum, Gogra, Alder, Oak species. Also occurs wild cherries and wild apples, wild lemon, wild banana, wild walnut, wild fig, varieties of edible plants and leaves, and cane and reed at selected places. At the foothill, Gomari, Holloc, Koroi, Mesua, Tita-Chapa, Neem, Wild Mango, Amla and Bamboo species are the dominant species. Varieties of shrubs, herbs-many with medicinal values, climbers, ferns and grasses are found. Varieties of bamboo are found in patches throughout the District. There also occurs a rare species of bamboo - finger size and cane - like in structure. The verdant forest of the District is also home to variety of fauna - a paradise for animals and birds lovers and researchers. Dominant wild animals includes Stag, Bear, Mithun, Sloth, Barking Deer, Mountain Deer, Wild Hog, the rare Pangolin, varieties of Monkeys, varieties of wild cats, varieties of Porcupine, Flying Fox, Flying Squirrel, Himalayan Giant Squirrel and other different varieties of squirrels, Civet Cats, snakes, Python, Otter etc. The rivulets and rivers teem with different varieties of fishes and other water creatures, of which trout is rare species. Dominant birds includes Hornbill, varieties of pigeons including royal pigeon, parrot, mama, mountain peacock, the rare and elusive Blythe's Tragopan, varieties of jungle fowls, and other varieties of smaller birds.

Agriculture

Rice is the stable food and Agriculture is the main stay of the people of Longleng District. Jhum cultivation is the most common form of agriculture, though wet paddy cultivation is seen practiced by a few in recent times. Some of the agri-products include rice, maize, varieties of vegetables, horticultural crops, etc. The low lying areas/Foothills of the District (bordering with Assam) is fertile and has the potential for wet paddy cultivation. Very few of the

people are engaged in white collar jobs and majority of the people are agriculturists. The area, production and productivity of major crops farming system of Longleng are here depicted below in the Table 3 and 4 respectively.

Table 3 Area, Production and Productivity of Major crops in Longleng (2014-15)

Sl. No	Crop	Area (ha)	Production (ton)	Productivity (q/ha)
1.	Summer paddy (Jhum)	7210	12920	1.79
2.	Autumn paddy (TRC)	210	700	3.33
3.	Mustard	1000	990	0.99
4.	Pea	340	300	0.88
5.	Potato	160	2070	12.94
6.	Rabi vegetables	490	2865	5.85
7.	Kharif vegetables	840	6925	8.24
8.	Maize	3030	6000	1.98
9.	Turmeric	50	230	4.60
10.	Zinger	220	2460	11.18
11.	Chilli	100	120	1.20
12.	Banana	320	3300	10.31
13.	Sugar cane	120	5240	43.67

Table 4 Major Farming Systems Prevalent in Longleng

Sl. No	Farming System
1.	Agriculture +Horticulture
2.	Agriculture +Aquaculture
3.	Agriculture +Horticulture+ Aquaculture
4	Agriculture +Horticulture+ Silvi-pastoral
5	Agriculture+ Silvi-pastoral

Shifting cultivation (*Jhum*) is the mainstay economy of the Longleng district and mainly dependent on monsoon rain. Mixed cropping pattern is followed during the *kharif* season. The average rainfall during the period of *June-September* (Monsoon period) is 1100-1300 mm. In spite of its high rainfall during monsoon season, there is acute shortage of water during peak period of crop growth especially in *rabi* season *i.e.* October to March. Most of the rainwater gets lost through surface runoff. Due to lack of irrigation facilities, a second crop is not possible in uplands, as a result cropping intensity is very low (115%) in the district. Keeping it in view, a simple low cost rainwater harvesting structure - *Jalkund* has been developed and popularize by the KVK, Longleng under Tribal Sub Plan (TSP) Project - 2013-14, 2014-15 and 2015-16 on "*Low cost scientific rainwater harvesting in Jhum areas"* to solve the problem of water scarcity.

The main objectives of the study

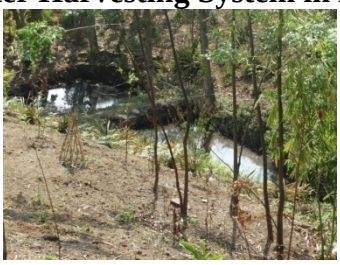
- To design, develop and evaluate a low cost scientific rainwater harvesting structure suitable for hilly agro-ecological zones of Longleng.
- To conserve rainwater in hill agriculture for effective and judicious use of water for livelihood development of *Jhumias* of the district.
- To estimate the water productivity (WP) and water use efficiency (WUE) of rainwater harvesting structure - *Jalkund* for irrigating crops, vegetables and for livestock animals.

Table 5 Participatory Rural Appraisal (PRA) Survey Analysis Results of Longleng District

Name of the block	Name of the village	Major crops & enterprises	Major problem identified	Identified thrust area
Longleng	Hukphang	**Cereals:** Rice, Maize, Millet **Vegetables:** Bean, Chow-chow, Ash Gourd, Pumpkin, Bottle Gourd, Cucumber, Cabbage, tomato, French Bean **Oil seed & Pulses:** Pyrella, Naga Dal, **Tuber crop :** Potato, Colocassia, Tapioca, Sweet Potato **Spices:** Chilli, King Chili, Large Cardamom, ginger **Fruits:** Banana, Orange, Pineapple, Local Litchi, Pear, Plum,	1.Water scarcity, 2.Low soil nutrient, 3.Predominant weed, 4.Low yield age - old crop varieties 5.Pre-dobminent *Jhum* (shifting cultivation) 6.Lack of scientific management practices, 7.Lack of conservation practices for soil & water 8. Lack of marketing facilities for agricultural produce. 9.Lack of food processing & preservation facilities 10. Poor communication & infrastructure facilities.	1. Rainwater harvesting & its recycling. *2. Jhum* (shifting cultivation) improvement 3. Nutrient Management. 4.Weed management 5.Varietal evaluation of crops & vegetables 6. Disease management of crop & Live- stocks. 7. Conservation soil and water through modified *Echo* structure, half moon terrace, bench terracing, contour bunding and contour trenching etc. 8.Value addition/ secondary agriculture 9.Seed production technology 10. Introduction of High yield breed of pig and poultry. 11. Double cropping 12.Integrated Farming System model (IFS)
	Lintak			
	Pongching			
	Bhumnyu			
	Dunkhao			
	Orangkong			
	Mongtikang			
Sakshi	Pongo			
	Hongnyu			
	Sakshi			
	Yongphang			
	Yingchang			
Tamlu	Yongam			
	Yongnyah			
	Tangha			
	Tamlu			

Traditional Water Harvesting System in Longleng District


Amosen (Tangha)


Namching


Yaong Yimchen


Yongam


Pongching


Namching


Tangha


Lingtak


Orangkong


Hukphang


Pongching


Oushok


Hukphang


Nyang


Lingtak

Before Intervention of Rainwater Harvesting Structure - *Jalkund*


Mongtikang


Pongo


Hukphang


Pongching


Nyang


Montikang

Method and Materials

Longleng people developed indigenous techniques for conservation and management of water in rainfed farming condition to sustain their livelihood. Indigenous Technical Knowledge (ITK) on rainwater harvesting is generally practiced in the District. Longleng people mainly collect runoff water flowing through the hill spring. At downstream outlet of the spring, they mainly construct earthen pond and collect the water for agriculture as well as for fishery purposes. They also collect water from the spring outlet in water tanker and carry to their home. Indigenous people also collect in plastic jerking, drum and buckets for their domestic use. Roof top rainwater is collected through gutter pipes and conveyer pipes to collect the water in the syntax or GI tank or RCC tank for their domestic consumption as well as for the rearing of pig and poultry. The photographs of ITK on rainwater harvesting by the Longleng people were taken during PRA survey and presented in this paper.

For construction of 40000litre rainwater harvesting structure - *Jalkund*, UV treated 300GMS (250µ) low density poly ethylene (LDPE) Silpaulin PVC sheet and 8,75lakh litre capacity spring water harvesting structure, UV treated 1000µ high density poly ethylene (HDPE) PVC sheet were used. The standard size of the LDPE Jalkund and HDPE water harvesting pond was 5m x 4m 2m and 35m x 10m x 2.5m respectively. Before construction LDPE Jalkund and excavation was done by manual labour whereas for construction of HDPE water harvesting structure was done by JCB m/c. After excavation of Jalkund structure the side and ground wall was plastered with a soil, cow dung, Aluminum Phosphate and water mixture (Soil: Cow dung = 5:1). After the drying of plastering, sufficient amount of banana leaf were laid on all around the wall and ground for giving a cushion before laying Silpaulin PVC sheet. Then the Silpaulin PVC sheet was laid on the banana cushioned excavated land and all sides were fix with bamboo stick. After sticking of all the side sides were earthen up with soil. An anchorage drain (25cm x 25cm) has to be constructed for draining out the runoff so that it cannot enter into the Jalkund. To reduce evaporation a lid made locally available thatch or toko leaf may used for covering the surface of the Jalkund. For protection of insects**,** pest and rodent, **s**praying of insecticide like *Rogor* on of the inner walls and bottom of the *Jalkund* and also application of *Aluminium Phosphate* @1tablet /live hole should be done. To check the evaporation loss, Neem oil @10ml/m^2 is used. Total 15nos of LDPE Jalkund were constructed during 2013-15. Total 9nos of farmers and 4nos of SHGs were benefited with the intervention of LDPE Jalkund and HDPE water harvesting structure (Table 6). The cost of construction of LDPE *Jalkund* was elaborated in the Table 7.

Total 8nos of HDPE water harvesting structures were constructed at Hukphang, Lingtak, Pongching (Longleng District-3nos), Kiphire (1no), Tuensang (1no.), Peren (1no.) and Wokha district (2nos).

Table 6 Name of the Beneficiaries, Village and Crops

Sl. No.	Farmers / SHGs Name	Size of *Jalkund* (m x m x m)	Capacity(litre)	Crops/ vegetables	Village
1	Hukphang Womens' SHG (10members)	5.0 x 4.0 x 2.0	40000	Chilly, Cabbage, Tomato, Cauliflower	Hukphang
2	Mr. Hatam Phom	5.0 x 4.0 x 2.0	40000	Piggery, Tomato, Chilly, Cabbage	Shayung
3	Muli Denthem SHG (10members)	5.0 x 4.0 x 2.0	40000	Cabbage, Chilly, Tomato	Oushok
4	Farmers' Organizer Group (30members)	5.0 x 4.0 x 2.0	40000		Pongo
5	Sunila SHG (10members)	5.0 x 4.0 x 2.0	40000		Orangkong
6	Mr. Wangshai Phom	5.0 x 4.0 x 2.0	40000		Nyang
7	Mr. Kapso Phom	5.0 x 4.0 x 2.0	40000	Off season vegetables	Yaong Yimchen
8	Mrs. Mhono Phom	5.0 x 4.0 x 2.0	40000	Ginger, Vegetables	Yaong Yimchen
9	Mr. Dingpa Phom	5.0 x 4.0 x 2.0	40000	Vegetables	Bhumnyu
10	Mr. Ngakusupong Phom	5.0 x 4.0 x 2.0	40000	Off Season Vegetables	Mongtikang
11	Mr. Chinglong Phom	5.0 x 4.0 x 2.0	40000	Off Season Vegetables	Namching
12	Mr. Shugngai Phom	5.0 x 4.0 x 2.0	40000	Chilly, Cabbage, Tomato, Cauliflower	Lingtak
13	Mr. E. Ongpha Phom	5.0 x 4.0 x 2.0	40000		Mongtikang
14	Mr. Chonglung Phom	5.0 x 4.0 x 2.0	40000	Cabbage, Chilly, Tomato	Pongching
15	Mr. Ango Phom	5.0 x 4.0 x 2.0	40000		Yongam
16	Mr. Pongmei Phom	35 x 10 x 2.5	875000	IFS Model	Lingtak
17	Mr. Shamjok Phom	35 x 10 x 2.5	875000	IFS Model	Pongching
18	Mr. Namei Phom	35 x 10 x 2.5	875000	IFS Model	Hukphang
19	USBLA NGO	35 x 10 x 2.5	875000	IFS Model	Kiphire
20	Better Life Foundation	35 x 10 x 2.5	875000	IFS Model	Tuensang

Table 7 Cost of Construction of *Jalkund*

Sl. No.	Work Components	Specification & cost
1	Dimension of the *Jalkund*	5m x 4m
2	Depth of the *Jalkund*	2.0m
3	Side slope of the *Jalkund*	1.5:1
4	Capacity of the Jalkund	40000lit
5	Excavation and plastering of side and bottom wall of Jalkund	Rs.5000/-
6	Lining with Silpaulin 200GSM poly-film sheet	Rs.7450/-

7	Formation of anchorage drain (25cm x 25cm) around the Jalkund	Rs. 800/-
8	Cost of bamboo for fence around the Jalkund and Labour charges for fence making & thatch covering	Rs. 500/-
9	Total cost (Rs.)	Rs.13750/-
10	Cost per cubic of water (Rs/m^3) i.e.1000 lit	Rs. 343/-
11	Cost per litre of water (Rs./l)	Rs. 0.343/-

Intervention of LDPE Rainwater Harvesting Structure – *Jalkund*


Nyang


Hukphang


Pongo


Mongtikang


Shayung


Oushok


Pongo


Oushok


Namching


Yaong Yimchen


Yongam


Yaong Yimchen

Intervention of HDPE Water Harvesting Structure in Nagaland for IFS model


Lingtak


Lingtak


Lingtak


Pongching


Hukphang


Lingtak


Tuensang


Kiphire


Pongching

Table 8 Results of Low Cost Rainwater Harvesting Structure-*Jalkund*

Enterprise	Problem diagnosed	Technology	Title of OFT	No. of trials	Parameters of assessment/refinement and its data in bracket	Production per unit crop (Kg)	Net return (Rs /ha)	B:C Ratio
					Technology Intervention			
Jalkund	Water scarcity	ICAR, 2006	Low cost scientific rainwater harvesting structure-*Jalkund* for *Jhum* Improv-	15	**1.Water Productivity** (kg/m^3) Chilli:0.34 Tomato:0.31 Cabbage:0.28 **2. WUE(kg/ha/mm)** Chilli:11.3 Tomato:10.7	1.Chilli: 80 2.Tomato: 123 3.Cabbage: 163	1600 4920 6520	1.73 1.67 1.77

			ement of Longleng		Cabbage:12.0			
					Farmer's Practice			
					1.Water Productivity (kg/m^3) Chilli:0.15 Tomato:0.13 Cabbage:0.17	1.Chilli: 48 2.Tomato: 67 3.Cabbage:74	960 2680 2960	1.21 1.23 1.12
					2. WUE (kg/ha/mm) Chilli:5.5 Tomato:6.3 Cabbage:5.9			

Results and Discussion

Jalkund-a low cost scientific rainwater harvesting structure successfully implemented in the *Jhum* areas of Hukphang, Pongching, Pongo, Shayung, Oushok, Nyang, Montikang, Yaong Yimchen and Orangkong village of Longleng district. In farmers practice, the water productivity (WP) of Jalkund were recorded 0.15, 0.13 and 0.17 kg/m^3, whereas in technology intervention it was recorded 0.34, 0.31 and 0.28 for Chilli, Tomato and Cabbage respectively. The water use efficiency (WUE) were recorded 11.3, 10.7 and 12.0 kg/ha/mm in farmer's traditional practices whereas it was recorded 5.5, 6.3 and 5.9 kg/ha/mm for Chilli, Tomato and Cabbage respectively in technology intervention. Benefit cost ratio of Chilli, Tomato and Cabbage was recorded 1.21, 1.23 and 1.12 in farmer's practices whereas it was recorded 1.73, 1.67 and 1.77 in technology intervention respectively.

Conclusion

Before intervention of rainwater harvesting structure people were cultivating their crops with ITK harvested water and water productivity (WP) and water use efficiency (WUE) of crops was less. After the intervention of rain water harvesting structure-*Jalkund*, the water productivity (WP) and water use efficiency (WUE) of crop increased significantly. The benefit cost ratio of crops also increased remarkably. After the construction of HDPE rainwater harvesting structure Integrated Farming System model has been developed at Hukphang, Lingtak, Pongching, Kiphire and Tuensang. This IFS model has increased their income to improve the livelihood of the local people. It is therefore, LDPE Silpaulin lined rainwater harvesting structure-*Jalkund* and HDPE water harvesting structure are recommended for *Jhum* improvement in the hilly region of the Nagaland.

Acknowledgement

Authors are very much thankful to the Director, ICAR, Umiam, Meghalaya and Joint Director, ICAR RC for NEH Region, Jharnapani, Nagaland for providing administrative and financial assistance for construction of LDPE rainwater harvesting structure-Jalkund and HDPE water harvesting structure at Longleng, Kiphire and Tuensang District of Nagaland.

Reference

Saha, R., Ghosh, P.K., Mishra, V.K. and Bujarbaruah, K.M. 2007. Low-cost micro-rainwater harvesting technology (*Jalkund*) for new livelihood of rural hill farmers, Current Science, 92(9):1258-1265

P. Chowdhury, B.C. Deka, M.K. Patra, Manoj Kumar and K.L. Meena. 2014. Micro Rainwater Harvesting Structure - *Jalkund* for Livelihood Improvement of Longleng.