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Indigenous Rainguage (*Rolu*)- A Tool to measure Rainfall

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ABSTRACT : Indigenous rainguage (*Rolu*) (IR) is one of the Indigenous technical knowledge, which helped the farmers in quantifying rainfall approximately for farm operations. It is a mortar made of granite with a hole of 22.5 cm f and 2000 ml capacity. Depending upon the depth of water received in the hole of IR, the amount of rainfall received can be known and farm operations can be carried out. To standardize IR, validation of IR was done in three on-farm conditions and two research farms of CRIDA, Rangareddy district, Andhra Pradesh for three years and a correction factor was derived as 0.48. Some refinements were also carried out during this process like making a barrier surrounding the hole and creating an outward slope on the periphery of IR to avoid overflow, splash and human interferences. It is concluded that when the IR is >1/2 to full, all the farmers (100%) are proceeding to sow crops like sorghum +pigeonpea and castor for 2-7 days and 3-6 days respectively. If the rain is filled to ¼th to ½ of the volume of the hole, they are carrying the operation of sowing for 1-2 days. Intercultural operations like weeding, topdressing were carried out for 2-4 days when IR is filled to >1/2 to 3/4th depth and about 6-8 days when IR is >3/4th to full depth.

Key words: Indigenous rainguage, Standard rainguage, correction factor, ITK

Sustainable production of crops in rainfed areas depends on conservation and efficient utilization of natural resources. Being resource poor, farmers have not been able to adopt many of the improved technologies emerging from the formal research system. Some of the reasons are high cost, lack of replicability and technologies not matching with resources and socio-economic environment of farmers. It is very important to characterize the traditional knowledge systems and integrate with the modern methods of production so that high production with sustainability is achieved. ITKs are designed to address the process of building harmonious relationship among man, animal and nature. These are time tested based on local resource experiences turning into practices (Das and Das, 2000). It is dynamic, holistic, integrated with religion and puts greater weightage on minimizing risks rather than maximizing profit (Warren, 1990). It is a tacit knowledge, which is not easily modifiable and can be transmitted orally, imitation and demonstration. It is an experience rather than a theoretical knowledge and adaptive skills of local people and often flow through overall traditions and learned through family members over generations. It is the knowledge being produced as well as reproduced, discovered as well as lost. Indigenous knowledge refers to the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area (Gremier Louise 1998). Documentation and validation of Indigenous knowledge is required to qualify and quantify the effectiveness of the practice for the benefit of researchers, planners and development officials. Suitable modifications of the local practices, through research and development will help to develop appropriate and acceptable technologies that are more suited to our farming situations.

Rainfed agriculture is beset with the problems of poor soils, ill distributed and low quantity of rainfall and it is imperative that timely sowing has utmost priority as the crop growth period is interspersed with the intermittent dry spells. Delayed sowing generally leads to experiencing intermittent dry spells during the crop period affecting the yield. Therefore, most of the farm advisory services are generally based on the rainfall received during crop period. These services can make use of the standard rainguages certified by India Meteorological Department, Pune. However, due to the area involved in big farms and watersheds, it is difficult to establish many rainguages that are theft prone. Therefore, an Indigenous rainguage (*Rolu*), which was documented, is validated and refined as an alternative to certain extent to the standard rainguage. This will generate an approximate estimate of the rainfall quantity received.

Materials and Methods

Indigenous Rainguage (Rolu)

The watershed areas, which are spread over many hectares, need to be monitored according to the rainfall received and distributed. There are standardized rainguages certified by IMD, Pune available. However, it is appropriate to fabricate an alternative rainguage, which can measure approximate quantity of rainfall, besides being inexpensive and theft proof. As a consequence of documentation of ITKs, we came across a mortar (*Rolu*) to measure rainwater. It is one of the Indigenous Technical Knowledge, which helps the farmers in estimating the rainfall whether it is sufficient to go for seeding, or not. This ITK was collected from the farmer of Nallavelli village, Yacharam Mandal, Ranga Reddy district of Andhra Pradesh, India. The predominant soil type of this area is *Alfisol* and the principal crops are Sorghum + pigeonpea and castor.

Rolu (Fig. 1) is a 22.5 cm ϕ hole in a granite stone block, which is useful in knowing the quantity of rainfall received for sowing. When the *Rolu* is filled with rainwater either with continuous rain events or a through a single rain event, then farmers go for sowing of seeds for 3-6 days. This method is adopted for sowing dryland crops like sorghum, castor *etc*., in *Alfisols*.

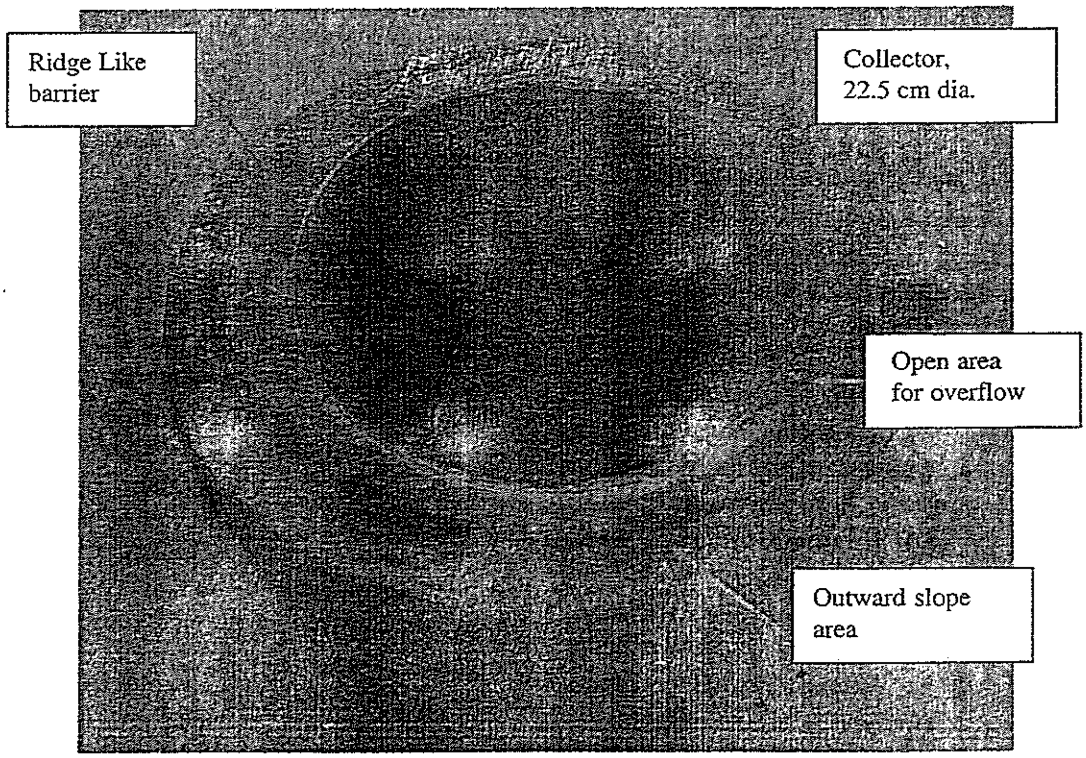

Fig 1. Indigenous rainguage

Origin:

This might have originated from the age-old practice of keeping mortar in the open space as the kitchens are built separate from the main building. Whenever there used to be rainfall, it was regularly observed over time that once the mortar is filled with rain water, they were sowing the fields for about 3-6 days during sowing month / with the onset of monsoon. In course of time, people started framing it as an indicator to approximate the quantity of rainfall received.

Procedure for validation of Indigenous rainguage

There are no standard packages to validate ITKs. Some are need to be validated at laboratory level, some at field level and some at both levels. The materials used in this experimentation are Indigenous rainguage made up of granite, Standard rainguage (SR), scale to measure the depth of rainwater in the hole and everyday monitoring of the sowing operations in the nearby fields (book keeping of farm operations in the nearby fields).

Discussion with the ITK discloser and fabrication of indigenous rainguage and Validation

Interacted with the discloser (farmer) to consider the finer details regarding Indigenous rainguage and its use. Rain gauges were fabricated with the help of a local mason with the specifications recorded as claimed by the disclosure. It has been standardized to a hole of 22.5 cm and 2000 ml capacity.

Validation was implemented under both on station (CRIDA Research Farms- Gunegal and Hayathnagar Research Farms) and on-farm situations (three villages) in the Ranga Reddy district of Andhra Pradesh, India for three years during 2002-2004. During *kharif* season, 2002 indigenous rainguages were installed nearby the standard rainguage to compare its efficiency in terms of recording rainfall related to the cultivation of rainfed crops of Sorghum + pigeonpea, castor *etc*., and sowing operation performed by different farmers in study area. The data on rainfall and the farm operations related to crops were documented in both the standard and indigenous raingusges. Further, the quantity of rainfall received in both indigenous and standard rainguages from June to September was correlated by taking the volume of water stored in two rainguages, considering the surface area, collected rainfall in each. Based on above parameters, a correction factor was calculated to correlate the quantity of rainfall received in IR with that of SR.

Determination of correction factor

The rainfall depths were calculated by measuring their corresponding volume of rainfall collected by the respective raingauges by using the equation:

$$R = (V_m/A_s) \times 10 \quad \ldots\ldots\ldots\ldots \quad (1)$$

Where,

R = Rainfall depth, mm
V_m = Measured volume of rainfall, ml
A_s = Surface area of respective rainguage, cm^2

A linear regression model as given below is considered in the analysis for deriving the correction factor (C_f) for relating the rainfall measured by IR and SR.

$$R_s = C_f \times R_i \quad \ldots\ldots\ldots \quad (2)$$

Where,

R_s = Rainfall depth measured by SR. mm
R_i = Rainfall depth measured by IR, mm

The loss of rainwater in the form of overflow, splash and human interferences were recorded. An outward slope is also provided to avoid overflow from the rainfall collecting area.

Results

Standardization of IR

After series of discussions and interactions of our team including the agro meteorologists with the farmers and the manson, the existing IR was standardized for accuracy in the measurement of rainfall as given below:

- Making a ridge like barrier surrounding the hole leaving the path for water to pass through one side maintaining same volume of rainwater as that of original IR;
- By creating an outward slope on the periphery of the indigenous rainguage to account for splash and human interferences etc.

Correction factor

The rainfall volume from both IR and SR established at different experimental sites was recorded. Simultaneously, the various agricultural operations done by the farmers were related with the rainfall received during sowing of different crops of sorghum+pigeonpea, castor *etc.* A linear regression model was fit into the rainfall depths calculated from both IR and SR. During the process, a correction factor was developed to quantify the rainfall of indigenous (IR) to test the validity of rainfall with that of standard (SR). The results are validated over the study area by developing a correction factor for its wide applicability by comparing with the theoretical correction factor. The collecting surface areas of IR and SR are 200 and 398 cm^2. C_f obtained was 0.48 when the linear model was validated with the rainfall data measured from the experimental sites, with high coefficient of determination($R^2 = 0.92$). The value of correction factor is as equal as theoretical correction factor of 0.5 which is the ratio of surface area of collecting rainfall of both IR and SR. Hence, for all practical purposes, the rainfall measured through IR could be converted into rainfall depths of SR, which is very useful for scientific planning of crops and their management practices in the farmer's field. Since the variability of rainfall in semi arid regions is very high, the correction factors have to be developed locally by installing IR and SR.

Correlation of rainfall from IR with reference to the rainfall recorded by the SR for carrying out Sowing and other farm operations

The quantity of rainfall from IR has been related with the sowing operation carried out by the farmers of the surrounding fields by recording the percent farmers sown with the rain events. This is presented in Table 1. Village wise on farm operations were recorded and presented below:

Table 1. Sowing operation being carried out in relation to the rainfall received in the IR (pooled data of 3 years for 3 on-farm stations and two Research stations)

Crop	Duration of operation (days)	Depth of water in IR	Percent farmers adopted
Sorghum+ pigeonpea	2-7	>½ to full	100
Castor	1-2	¼ to ½	100
	3-6	¾ to full	100

Nallavelli

The initial rains of 10 mm (R_i >1/4 full was utilized for preparatory cultivation and the next rains (3/4 full) was utilized for sowing Sorghum+pigeonpea which is 100% in this village. Similar rain received later was utilized for the interculture and top dressing. However, the crop was immediately harvested with an yield of 3.5-5 q ha^{-1}. Castor being a late sown crop is sown always with the next rains (Table 2).

Nasdiksingaram

All sorghum farmers had sown the crop when they received >1/2 to full depth rain in IR in all the years. When similar quantity of rainfall was received during July, two days were for tillage to sow castor and sowings were done for the next three days after receipt of rainfall (Table 2).

Gollapally

Castor is the major crop in this area and generally it is sown in July as and when the rains received are ½ to ¾ full (cumulative rainfall). It helps the farmers in getting good germination of castor seed in the fields as they are hard coated (Table 3). Depending upon the time of onset of monsoon/ rainevent, the sowings of Sorghum+ pigeonpea was done by all the farmers within 2-7 days when the IR is >½ to full while for castor, when the IR is ¾ to full, all the farmers had sown within 3-6 days.

Overflow events

33 years rainfall of Hayathnagar Research Farm of Central Research Institute for Dryland Agriculture, Hyderabad was analysed (Table 5) for overflow events (1971-2003). The overflowing rainfall events depend on the amount of rainfall received and its distribution in the respective months. The probability of receiving overflowing rain events ranged from 10-28%. Though the probability of receiving overflowing rainfall events is less, the refinement in terms of reducing the diameter/ collection area, retaining the capacity (volume) of the IR will reduce the overflow. Therefore, the confidence of recording the rainfall events with this IR will improve by not losing even a single overflow event.

Discussion

The experimentation in three villages and two research stations proved that when the IR is > ½ to full, the farmers proceeded to sow sorghum + pigeonpea for 2-7 days and castor for about 3-6 days. However, if it were less, sowing for 1-2 days would be carried out. If it were still delayed, only castor crop would be sown. Correction factor of 0.48 is used to arrive at the rainfall of SR by multiplying the rainfall recorded in IR with C_f. Refinement to suit different locations can be carried out keeping the surface area narrow without affecting the capacity for its wider applicability, for overflow events observed in that area and for losses due to splash and human interference. Farm advisory by the NGO's or any other organizations can be given based upon the volume of rain that is received within the IR even in remote areas. IR costs around Rs. 250-300/unit as against the cost of SR for Rs. 3000-3500/ unit in the market. IR has multiple utilities of recording as well as in preparation of various food products for consumption. The IR would help in accurate measurement of rainfall in remote areas, where to install SR is a remote possibility because of theft problems.

Table 2. Effect of rainfall received (Std(SR) and indigenous rainguages) (IR) on duration of agricultural operations carried out in Sorghum+ppea and Castor crops

Operation	2002 Rainfall (mm) SR	2002 Rainfall (mm) IR	2002 Duration of operation (days)	2002 Farmers practiced (%) S + PP	2002 Farmers practiced (%) castor	2003 Rainfall (mm) SR	2003 Rainfall (mm) IR	2003 Duration of operation (days)	2003 Farmers practiced (%) S + PP	2003 Farmers practiced (%) Castor	2004 Rainfall (mm) SR	2004 Rainfall (mm) IR	2004 Duration of operation (days)	2004 Farmers practiced (%) S + PP	2004 Farmers practiced (%) Castor
Nallavelli															
Sowing	8 (1)	28	4	100	-	32.8 (1)	95.4- **>3/4**	6	100	100	20(1)	40- **>1/2**	2	100	1
Interculture	1 (1)	2.4 -**<1/4**	2	50	60	2.8(1)	5.8	3	90	-	24(1)	46 **>1/2**	4	100	100
&Top dressing	14.2(2)		4	50	35	32.6 (4)	88.2- **>3/4**	5	-	100					
Sowing		38.4 – **>1/2**													
Nasdik singaram															
Sowing	25.2 (1)	-	11	100	-	8 (1)	36- **>3/4**	3	100	100	19.5(1)	41.2- **>1/2**	2	100	-
Interculture and Top dressing	24.1 (4)	80- **>3/4**	6	75	50	44.4(2) 14.5(4)	129- **full**	8	100	50	20.3(3)	59.3-**3/4**	4	80	100
Sowing							33.1- **>1/2**	1	-	50	35.2(1)	93.2- **>3/4**	1	20	-

Figures in parenthesis are number of rainevents; figures in italics and bold are the depth of hole filled with rainwater
S : Sorghum , P P : Pigeonpea

Table 3. Effect of rainfall received (Std (SR) and indigenous rainguages) (IR) on duration of agricultural operations carried out in Castor crop in Gollapalli

Operation	2002 Rainfall (mm)		2002 Duration of operation (days)	2002 Farmers practiced (%)		2003 Rainfall (mm)		2003 Duration of operation (days)	2003 Farmers practiced (%)		2004 Rainfall (mm)		2004 Duration of operation (days)	2004 Farmers practiced (%)	
	SR	IR		Sorghum +ppea	Castor	SR	IR		Sorghum +ppea	Castor	SR	IR		Sorghum +ppea	castor
Sowing	7(2)	-	2	-	50	18(2)	38- **>1/2**	3	-	100	7(2)	19.5- **>1/4**	3	1	100
Interculture & Top dressing& Sowing	27(2)	**33->1/2**	4	-	30	39(20)	96- **full**	2	-	50	34.3 (4) 6.3 (3)	66- **>3/4** 17- **>1/4**	6 4	-	50 50

Figures in parenthesis are number of rainevents; figures in italics and bold are the depth of hole filled with rainwater

Table 4. Probability (%) of receiving overflowing rain events in HRF of CRIDA, Hyderabad as per IR (> 50 mm) (Data: 33 years)

Month	Total rainy days	Overflow events (>50 mm)	Probability (%)
January	15	3	20.0
February	18	4	22.2
March	21	5	23.8
April	52	5	9.6
May	86	15	17.4
June	213	43	20.2
July	300	64	21.3
August	295	70	23.7
September	247	65	26.3
October	189	52	27.5
November	66	13	19.7
December	14	3	21.4
Total	**1516**	**337**	**22.2**

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