In-situ Soil, Water and Crop management in dry land ecosystem

-An approach by Farmer Field School

J.Krishnan, Team Leader, AME Foundation, Dharmapuri & Ph.D. Scholar, Gandhigram Rural University

Water and Crop in dry land is seldom observed now-a-days; a holistic natural resource development would be the vision of any watershed program that should necessarily optimize the use of land, water and vegetation. It is known fact that watershed development offers an unique possibility to reverse land degradation and to promote more favorable ecological balance leading to healthy environment. It also has mandatory aspects of managing drought and floods, preventing soil erosion, improving water availability, increasing food production, fuel, and fodder on a sustained basis. It is apparent that over 20-30 years, there has been uncountable number of watershed efforts being taken up in thousands of hectares across country, but its impact on dry land is still unnoticeable. Rain water in dry lands for seasonal crops is always in dwindling stage and even one successful crop is difficult task to achieve. This situation creates un urge to think of **'capturing rain water in farm land'** to by the first priority that needs highest attention than creating centralized structures such as check dam, percolation pond etc.. in watershed program. These structures are always supportive in groundwater recharge towards resourceful low land area. Hence, it is high time to think of reversing the concept of watershed and relook on its approaches. A strategic approach needs to be as **"Capture rain first, use it soon for crop and conserve later"**. That way, paying more attention on rain water capturing in dry lands and use it soon for successful crop production is an important step. While, capturing becomes top priority, taking up appropriate immediate cropping is also equally important to achieve successful return.

This way of looking at reversing the concept of watershed right from farm land is equally important as that of following ridges and valley approach in bigger watershed area. It is obvious that the rain fall in dry lands erode the rich top soil and transport to the lower reaches depositing in village level open tanks. At this juncture, farm level water conservation would create perfect checks on farm land itself, thereby run off loss of rain water and fertile soil movement to the lower reaches can be minimized a lot. Hence, decentralized approach in watershed program is very much essential. ***Because, the success of watershed program should ensure moisture to the root zone of growing crops*** than harvesting and stagnating water in big structures which are generally not reachable by dry land crops but recharges groundwater only. This way, the crop utilization becomes main priority than merely letting water down to percolate or evaporate; instead subjecting them into transpiration loss through crop utilization would pave way for strengthening hydrological cycle of the area also.

On this score, AME foundation has taken up concerted efforts in field through Farmer Field School program conducted in dry lands of various villages in Pennagaram block of Dharmapuri district. Tamilnadu.

The ground reality:

Pennagaram taluk of Dharmapuri district of Tamilnadu, India, is unique in its geographical settings with undulated topography embedded with low natural resource profile. The district is located on the western side of the Eastern Ghats and is mostly a hilly terrain. The district has 3.46 percent (4498 sq. km) of the state's geographical area and most of it is undulations with varying slope. Though the river Cauvery is passing through the western side, the radiating catchment area and the tributaries mark the nature of watershed. Pennagaram being situated nearby to the Cauvery river flow no benefits received due to hilly terrain topography, hence, most of area's production affects due to water scarcity and people suffer lot for drinking water. Pennagaram Block consists of plains and a valley with variable soil conditions having an elevation of 450m above the MSL.

Groundnut being main dry land crop stand as main protein source not only to the farming people also to the livestock by feeding on haulms. This, being livelihood crop also carry other major inter crops of Red gram, cow pea, lab lab etc.. are potential protein source and fulfill yearly food reserve at their home level. In case, if rain fails, they loose the opportunity for groundnut and go in for grain crop like Ragi/Samai due to their drought withstanding capacity.

Groundnut as it fulfills triple objectives of Cash earning, protein security to farm families and farm animals by feeding kernals and haulms, direct protein source helps all age groups to cater their need. Besides, groundnut, they get yearly protein reserve from red gram, lab lab, cow pea upon harvest. But of late, during last two decades, there were frequent failures in dry land crop production due to scanty rainfall. Farmers started migrating to nearby cities for non-agriculture work and started selling the farm animals as they could not fulfill their water requirements. The scenario of prolonged dry spell and absence of rain fall became routine and the seasonal crops got affected. Also the degraded land resources, very less organic matter content, declining ground water table, high run off of rain water leading to water and soil erosion, inappropriate production practices such as mono cropping, indiscriminate use of chemicals especially in irrigated lands, resources intensive crops, all have resulted in unsustainable farming.

Decentralizing Watershed approach:

Although watershed is seen in context of bigger area treatment creating centralized structures like major check dams, creation of big farm ponds, percolation ponds, contour bunding, desilting of open tanks, check weirs, gully plucks etc..that their benefit generally do not reach dry lands. Instead, taking simultaneous efforts in farm lands creating decentralized structures like water harvesting mini ponds, open land rain water harvesting, across ploughing, ridges and furrows, bunds and trenches all along field border are very essential.

Therefore, considering past and present watershed experience, effort should starts right from small dry land holdings. keeping the current scenario of global climate change in mind, it is essential to **Capture rain water first, Use it soon and Conserve the excess later.** Because water in dry land has become so scarce commodity, if not used soon on its receipt, it is lost by evaporation and percolation within no time. Therefore, it would be wise to use summer rain with

immediate sowing than conserve it for Kharif cropping, because there is no guarantee that neither the stored up moisture nor the rain will continue till Kharif season.

In fact, like major watershed area, there has been clear cut point of drainage (called mouth) in dry lands too and it is generally observed that the rain water during rain drains from every point through numerous sub-drainages. Topographically, the mouth located at lowest point. The point of drainage develops into small stream runs to lower reach of the farm lands. There is clear cut boundary line (called divide**)** on top of the uplands with surrounding ridges showing clear cut ridge line of watershed between dry lands.

The Initiative

AME Foundation, a developmental organization, started working in 5 villages of Pennagaram block of Dharmapuri, by implementing Dharmapuri Farm Initiative (DFI) project funded by Wheels India Ltd (WIL), Chennai, in the year 2012 that expanded to 40 villages by 2017-18. It started work with an aim to help dry land farmers move towards resilient farming systems for successful crops by adopting water management and appropriate crop production practices. Accordingly, in all the villages, preliminary meetings were conducted to interact with the communities and explain the purpose of the intervention. Gramasabhas were organized to inform the village communities and the local leaders about the purpose of intervention and to seek their support. Participatory Rural Appraisal (PRAs) were conducted in all the villages to get to know about the village situation and most importantly to understand about people, their conditions, their livelihoods, their challenges and limitations. This followed the Farmer Field School (FFS) program conducted for the entire crop season right from land preparation till post harvest phase. *FFS is the prime methodological approach of AME; Ecological agriculture is the main principle production practices being taught to the farmers*.

In-situ soil and water conservation:

AME had close assessment on existing ground situation involving small and marginal farm families especially women folk in Participatory Rural Appraisal (PRA) to assess their natural resources for potential growth plans. Based on PRA findings, problems were prioritiesed in participatory way, FFS curriculum on dry land ecosystem management that included crops specific, land specific, water specific issues along with solution to address. In each of 30 villages FFS events were conducted involving farmers of respective villages. FFS famers allocated half an acre for implementing the FFS learnings and keeping control plots to compare. The activities were started in each farm lands right from soil and water conservation that concentrated across ploughing, trenches and bunds, mini farm ponds to stop the soil erosion and capture run off rain as much as possible. Application of 5 tonnes of well decomposed FYM to enhance water holding capacity of the soil thereby supporting growing crops with optimum moisture condition.
Capturing of rain water on ground surface in ridges and furrows across slope needs to be the first step where excess run off rain is stored into mini farm ponds for the immediate cropping program. An equally important step is direct harvest of rain in open lands using drums, water tanks etc. installed above the ground level in raised manner. This water could safely be used for the crops during critical growth period as protective irrigation.

Table 1: Impact of in-situ Soil and water conservation in farm lands (Cumulative Average of 20 villages):

Name of Resources	2012-2013 5 villages		2013-14 10villages		2015-16 15 villages		2016-17 20 villages		Total	
#Water (lit.)	No of Trenches	Qty.	No of Trenches	Qty.	No of Trenches	Qty.	No of Trenches	Qty.	Trenches 10000	900000 (lit) of water
	1000 (200x5)	90000	2000 (200x10)	180000	3000 (200x15)	270000	4000 (200x20)	360000		
#Soil (kg.)	1000	75000	2000	150000	3000	225000	4000	300000	750000 (750t) of soil	
Note: *Average 10 pits per members in 0.5acre; totally 200/village every year. On an average 75kgs/pit conserved. #Soil & water conservation from 2 rains. Trench /pit size: 1x1x3(dxbxl)=3cft; 1cft=30lits;90lts/trench										

Table 2: Estimates of soil and water conserved

No. of Trenches	Qty. of water harvested (lt.)	Qty. of Soil conserved (kg.)
4000 (@200 trenches/villagex20 village)	3,60,000	3,00,000
Trench /pit size: 1x1x3(dxbxl)=3cft; 1cft=30lits;90lts/trench		

Crop management

1. Summer Cropping - An innovative approach

Monsoon rainfall is a gambling factor, highly uncertain and erratic in dry lands. When dry land production totally dependent on rain fall that directly affects the economic situation of farm families if it fails. In recent years Dharmapuri district had witnessed repeated crop failures, more importantly the Pennagaram block has been worst affected. The crops like groundnut, ragi, samai, jowar etc. sown in Kharif got affected repeatedly. While the summer ploughing was the customary practice that everybody follow, the continuity of further rains till June for Kharif sowing got failed.

On the other hand, the moisture stored up through summer rain in April was totally lost within no time as the continuing rains failed; hence, the kharif crops in June could not use it.

The field experience of FFS proves that the summer cropping is quiet possible to achieve. AME first tried out with sowing of sun hemp in April on receipt of first summer rain as a measure to increase the biomass and fertility status of soil in dry lands. Then, in-situ ploughed at flower stage, allowed for decomposition period of 15-20 days and moved for kharif crop like groundnut in June.

Keeping such experience in mind, as adaptation strategy to address repeated crop failures, had decided for short term grain crops instead of sun hemp. This decision was made in FFS involving all the participating farmers as an additional cropping choice prior to kharif crops. Accordingly, 0.5 acre of dry land as trial plot by each participant of FFS had allocated for taking up summer crop using summer rain. As crop choice, the FFS group decided to broad cast either Cow pea or Green gram. During 1st summer rain in April 1st week, the member farmers broadcasted 8 to 10 kgs of Cow pea seeds in 0.5 acre of dry land where, some had opted Green gram of similar seed rate in 0.5 acre. Farmers were so happy to see the crops seeds started germinating within 3 to 6 days and continued to put forth 2-4 leaves with better crop stand. And there was another shallow summer rain happened during 40th day after sowing that supported the crop entering into reproductive stages of flowering and fruiting. During 50th to 60th day onwards the pods of black gram and cow pea started maturing and the farmers successfully harvested the pods by 60 to 65th day by hand picking. It was unbelievable to see that the cow pea harvested was 180 to 200 kgs from 0.5 and Black gram was 80 to 95 kgs. They had applied neither fertilizer nor pesticide. And more importantly there was absolute nil in pest occurrence, as most of pests were in pupal stage during summer.

2. **Kharif cropping:** The summer cropping followed the Kharif season crop sowing with groundnut crops resulted in successful harvest. As the in-situ conservation practices maintained better soil moisture that supported better crop with growth and establishment, the critical crop growth phases such as flowering, peg formation and pod formation stage went on well without moisture stress and resulted remunerative yield output. The cropping system followed by farmers in trial plots was groundnut as main crop, red gram and lab lab as intercrops, sorghum as border/ barrier crop and castor as a trap crop.

3. **Second/Sequential cropping:** On completion of groundnut harvest, horse gram was sown as 3rd crop using the available residual moisture in each of 0.5 trial plot and harvested 187.4 kgs on an average. The details of yields of various crops raised in summer and kharif season are furnished in table as under:

The table-3 reflects that the possibility of three time crop cultivation following in-situ moisture conservation measures along with ecological farming practices in dry lands. The success of summer crop gives great hope to farmers with additional crop yield/income prior to kharif seasonal crops.

Table 3: Average yield of 600 trial plots from 30 villages/each trial plot is 0.5acre:

Summer crop (April to June 1st week)	**Kharif season (June to October)**					**October to December**
	Main crop	Inter crops		Trap crop	Boarder crop	2nd crop after groundnut harvest
	Groundnut	Red gram	Lab lab	Castor	Sorghum	Horse gram
Avrg. yield	640 to 800 kgs.	120.6kg	71.4kg	19.6kg	12.8kg	187.4kg

Following table-4 reflects on farmer/eco friendly ecological practices followed in trial plots (FFS plots) lands to address the issue of moisture stress and crop failures in dry land farming.

Table 4: LEISA/Ecological farming practices followed in farm lands as below:

Activities	**FFS Farmers**
Production activities (LEISA based)	1) Across ploughing 2) Bunds and trenches along borders 3) Mini farm ponds 4) Rain water harvesting using roofs 5) Application of 5 tonnes of FYM/0.5 acre 6) Bund planting 7) Application Rock phosphate 8) 300 kgs of enriched FYM with bio-fertilizers of Rhizobium, Psuedomonas, Trichoderma (anti fungal) 9) Seed treatment with bio-inputs 10) Summer cropping with Cow pea/Green gram or Raising sun hemp and in-situ ploughing to improve biomass. 11) Seasonal Main crop (groundnut/millet) withTwo inter crops (red gram, lab lab) 12) Cholam as border crop to prevent sucking pest entry 13) Castor as trap crop 14) No fertilizer appln. 15) No pesticide appln. 16) Application of gysum 17) Weeding and earthling up 18) Mulching 19) Yellow sticky traps (5-8nos./0.5acre)

It is thus clear that adoption of farmer friendly practices through FFS such as in-situ soil and water conservation, enhancing crop biodiversity has several advantages in terms of improvement in soil water holding capacity, soil fertility, pest management, crop yields, costs and returns, and environment. While, this ecosystem based approach saves farmers from crop failures, it enriches farm and village level micro climate primarily and this shows the way for addressing the focus of global climate resilience.

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