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CONJUNCTIVE WATER MANAGEMENT:

An approach & technologies for successful cropping under rainfed conditions in Anantapur District

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1. Introduction:

Rainfed farmers of Anantapur district are in severe distress due to repeated crop failures due to droughts. The problem was analyzed, causes were identified and possible solutions are field tested with farmers. It is all done in consultation with the scientists of Agricultural Research Station, Anantapur, Worldwide literature, farmers of Anantapur, NGO's and officials of District Administration. AF Ecology Centre tested the approach and technologies on farm with farmers with about 2000 farmers in 8 mandals in Anantapur district. The results clearly indicate the possibilities of not only drought irrigation but also increased crop production across the District provided an enabling policy framework is developed and the approach & technologies are scaled up with appropriate programmes. The emerging concept is "Conjunctive Water Management" to combat drought, enhance agri-production, revitalize rural livelihoods inorder to achieve well being of farmers, farm labour and other in the rural areas in the District.

1.1 Rainfall analysis indicates certain pattern of drought occurrence:

The main reason for the droughts is low and erratic rainfall in the district. However rainfall of 25 years in 8 mandals of the project area was analyzed and found certain patterns in the occurrence of droughts. The analysis and important patterns of rainfall causing droughts are as follows.

1. Year to year variation of rainfall is more than 30% and it ranged from 280 to 750 mm.
2. Timely and adequate rains for sowing did not occur in July in 50% of the years.
3. Amount of sowing rain ranged from 10mm to 40mm.
4. The second sowing rain came from 7 to 35 days, after the first sowing rain. (It indicated either delayed sowing or low sowing)
   Thus timely sowing could not be done by farmers in 50% of the years. It is a major cause for droughts. Many a time only partial sowings were done in time. Timely sowing under sufficient moisture condition is a critical factor for successful crop under rainfed condition. So, many droughts (almost 50%) occurred because the timely sowings did not take place for want of adequate moisture or sown under inadequate moisture where the germination was affected and initial growth was stunted affecting the yields.
5. Dry spells (rainless period of more than 7 days) occurred every year. The number of dry spells ranged from 2 to 4 during the crop season (June to November). The duration of dry spells ranged from 10 to 45 days. Mostly the drought causing dry spells occurred around August. Many years dry spells occurred more than 15 days. In some years 45 days or more also.
6. A rainfall event is beneficial only when it rained more than 10 mm.
   These dry spells are the second most common cause for droughts. Generally rainfed crops like groundnut, millets or pulses survived a dry spell of 15 days. More than that either the yields are diminished or crops totally failed. Thus the incidence of droughts were caused by the longer than 15 days dry spells during the crop life. Generally the intensity of drought depended on the duration of dry spells.
7. Wet spells (continuous rainfall more than 2 days) occured in September and October months.

When a wet spell occurred of 3 or 4 days particularly at certain stages of a crop, high vegetative growth takes place but yields would come down (deceptive green). And when the wet spells occur at harvest time, particularly groundnut, the produce also get damaged.

8. High rainfall events (more than 40 mm / day) occured are 2 to 6 during the crop season. (Runoff events occured if the rainfall is more than 40mm).

   Based on the detailed analysis of the rainfall two main drought causing trends were identified.

   1. Lack of timely sowing in the month of July.
   2. Prolonged dry spells (post-sowing) during the cropping season particularly around August.
   3. One opportunity is identified in the analysis of rainfall; runoff inducing high rainfall events help in harvesting rain water in farm ponds for subsequent use.

2. An approach and Technologies for successful cropping under drought conditions: Conjunctive Water Management:

In order to combat the droughts and enhance the agricultural production, the proposed solution is conjunctive use of water. It involves making the best use of rainfall, (however low & erratic) and supplement it with surface water or groundwater or river waters whichever is convenient. And incorporate technologies, practices systems and infrastructure required for Conjunctive Water Management. Technologies and practices which are critical for combating droughts and enhancing crop-production are tested with farmers and explained here under:

2.1 Technologies for timely sowings in the absence of rains in July.

2.1.1 Anantha Planter

The amount of sowing rains required would be 2 rain events of atleast 20 mm each in July with a gap of about a week. The minimum amount of rainfall required for sowing is 20 mm to receive in one or two consecutive days. Sowing can be taken for 2 days if the rainfall is 20 mm and it can be taken up to 4 days if the rainfall is more than 30 mm. The general problem faced by farmers is that with one rain event their sowing in half done or less. For the rest they need another one or two events in July to complete the sowings in time. The conventional sowing equipment covers only about 5 acres in a day of 8 hours of sowing. Since the sowing time available is only 2 to 4 days efficient equipment is needed for rapid sowing with minimum troubles or problems. Anantha Planter is one such equipment developed by Agricultural Research Station, Anantapur.

Anantha Planter is a 8 tyned cultivator with spring tynes. The seeding mechanism is inclined plate mechanism and being moved by ground wheel. Anantha Planter can be used for sowing groundnut, castor, Bengal gram, red gram, sorghum and horse gram by selecting suitable seed disk. Uniformity of seed spacement is achieved by the seed disk and a short distance from hopper to soil. It can cover 15 acres in a day of 8 hours. It enhances the efficiency of sowing time by 100% or more. The strong blade attached to the implement covers the seeds and destroys the germinating weeds. The implement costs about Rs.66,000. The implement was tried 1,300 acres and the results are encouraging. The farmers are happy with the implement.

2.1.2. Aqua Planter

Aqua Planter is meant to sow under low moisture conditions. It can also be used even when sowing rains are not received. It is made of Anantha Planter mounted with 2 drums of 200

liters capacity each on the frame. When the planter is in operation, it drills water and seed simultaneously and covers the furrows with blades attached to it. The amount of water required for sowing of crop depends on the soil moisture. For sowing in a dry soil 20,000 liters is required for close growing crops like groundnut, jowar, bajra etc. For castor or red gram 5000 liters of water is sufficient. The quantity of water can be reduced depending on the availability of soil moisture. An area of 4 acres can be sown in a day of 8 hours. The present cost of the machine is Rs.85,000. Aqua Planter was tried in 60 farmer's fields and the results encouraging.

2.1.3. Row Water Sowing

Row water sowing technique can be used for wildly spaced crops like castor or red gram in low moisture conditions or in the absence of sowing rains. Shallow furrows are opened with a plough and seed is placed in the furrow. Water is applied in the furrow through tractor tanker. Furrows are closed by harrowing. The amount of water required is 5000 to 8000 liter per/acre depending in the soil moisture. Six acres can be covered in a day of 8 hours. The cost of water for one tractor tanker of 5000 liter capacity is Rs.700 to 800. A farm pond with lining might be a source of water on the farm itself. Crop sown with row water technique can survive up to one month. This method was tried in 40 farmer's fields and found encouraging.

2.2. Technologies for addressing prolonged dry spells

2.2.1. Lined farm ponds

A typical size of farm pond is 10mX10mX2.5m for red soils for 5 acres of cultivated field. Farm pond is lined with soil cement mixture in 6:1 ratio. Six parts red soil and one part cement is mixed with water and all sides of the pond is lined with mixture. The farm pond can harvest up to 2.5 lakh liters and retain upto 3 months. The stored water can be used for either sowing in time with Aqua Planter or for providing protective irrigation during the dry spells. The minimum amount of water to be applied as protective irrigation depends on the crop. For red gram or castor 8000 to 10000 liter per/acre may be applied by side of row through drip or furrow irrigation method. About 5000 liters per acre is needed for watering of one acre of mango orchard for one irrigation. For close growing crops like ground nut, green gram, sorghum, pearl millet etc. 40,000 liters per acre is necessary. It is to be applied by sprinkler method. The amount of water in farm pond will be sufficient for 5 acres of groundnut for one irrigation or 20 acres of castor or red gram or 5 acres mango orchard for three months. The cost of the lining of farm ponds works out to Rs.6000 (4000 for cement and 2000 for lining). Digging farm pond works out to Rs.10,000 and mostly it is done under MGNREGS. Research data available at Agricultural Research Station reveals that the ponds are filled in 24 years out of 25 years. Farm ponds were filled at least twice in a year for 20 years out of 25 years. The run off causing events in several mandals are more than two in a year.

Twenty farm ponds are lined in the project area during the year 2014-15 when the rainfall was 50% deficit during the crop season. Out of them, 18 filled once, five filled twice and one filled thrice. Most of the farmers used the water for watering mango plants. Each farm pond was able to provide water for three months for 5 acres.

2.2.2. Protective irrigation for red gram

Row irrigation technique was used for providing protective irrigation to widely spaced crops like castor or red gram. The method of irrigation is either by drip or by furrow irrigation. The

quantity of water to be applied is 5000 to 10000 litres per acre. Protective irrigation is provided when dry spell is more than 15 days. Castor is sensitive at seedling stage and flowering stage where as red gram is sensitive at flowering stage. Tractor tanker is used for this purpose.

In the project area, protective irrigation was given to 100 acres in 2013 and 1000 acres in 2014. It was given to intercropped red gram after harvest of the groundnut in the month of November. The yield increase in red gram is 75 to 100%.

2.2.3. Protective irrigation to groundnut

Groundnut is sensitive to moisture stress particularly at pod development stage. Protective irrigation was given with mobile sprinklers when the dry spell is more than 15 days. The amount of water applied was 40,000 liter per acre. Sprinkler irrigation was given with tractor with a unit called PTO for pumping water or for running sprinklers. A PTO unit costs is Rs. 8000/-. Eight raisers of sprinklers were used each time for one tank of water. Total 8 tanks of water was needed for one irrigation. The increase in yield was 25 to 40%. These trials were done in 10 acres. In addition 100 acres of different crops like tomato, sunflower, rice, citrus and vegetables were saved with mobile micro irrigation unit.

2.2.4. Source of water for timely sowing or protective irrigation.

The possible sources of water for supplementing the gaps in the rainfall are (1) Farm ponds, (2) Other water harvesting structures like check dams, percolation tanks, old tanks etc. (3) Bore wells. Water markets are also emerging, where in water is being sold at Rs.300/- to Rs.800/- per 5000 litres.

However purchasing water, transporting by a tanker and providing irrigation is expensive and benefit to the farmer might be diminished.

3. Conjunctive Water Management: A sustainable approach to not only drought mitigation but also higher crop yields.

3.1 **Not only drought mitigation even yields can be increased atleast by 50%:**

The above experiments essentially indicate a feasible approach to drought-proofing in the chronically drought-prone District of Anantapur and other similar agro-climatic conditions. Significantly they even indicate that the yields of rainfed crops could be enhanced by more than 50%. For eg., the average yield of groundnut under rainfed condition in Anantapur is about 400 kgs. per acre, whereas the same under irrigated condition is 800 to 1000 kgs. Obviously the difference is attributed to timely watering and better crop management practices.

Therefore a Conjunctive Water Management approach is proposed. When rain moisture is supplemented during the dry spells sufficiently with surface water or ground water, not only the droughts could be combated but also yields could be enhanced by atleast 50% if not more. The analysis of rainfall and the pattern in the incidence of droughts proved that one to three dry spells are causing droughts. If these dry spells are dealt with supplementary irrigation, using available surface water or ground water or river waters then there is no drought. Further under assured supplementary irrigation conditions, the farmers would also improve the crop management practices the same as under irrigated conditions and that would ensure higher yields by 50% or more.

Neither the dry spells nor the rains occurred uniformly in the District. There are always some parts of the District better off than others. So the water requirement would be varying

depending on how much area is affected by dry spells at any given time. General tendency is about 50% of the cultivated area may be in need of a couple of supplementary irrigations in a crop season.

Another significant thing is that the entire cultivated land in Anantapur of 27.5 lakh acres both rainfed and irrigated can be cropped and protected with supplementary irrigation for Kharif season. Additionally the entire irrigated land under bore wells can be commanded for second crop in the Rabi season.

3.2 Enabling conditions for an effective conjunctive water management:

3.2.1 Farm ponds for every 3 to 5 acres:

Farm ponds with lining for proper on-farm rain harvesting and storing without seepage should be constructed for every 5 acres or less across the District. Thus the water for atleast one supplementary irrigation is made available right on the farm, which might serve for timely sowing or supplementary wettings during the dry spells.

3.2.2 Fill-up the Water bodies (Anantha Jalavalayam) with water from HNSS Project:

There are about 3000 small and medium water bodies like big check dams, kuntas and cheruvus in the District. They receive some water by rain and they need be filled with water from HNSS project for maximizing the benefit of Conjunctive Water Management. It is called Anantha Jalavalayam (Anantapur Water Grid). It serves 4 very important purposes. Viz. (1) Recharges the groundwater, (2) Makes water available across the District for supplementary irrigation for rainfed crops during dry spells. (3) It provides water for cattle, birds, wild life etc. (4) it provides water for fisheries and other livelihoods like washer men.

3.2.3 Quantity of Water required for supplementary irrigation to rainfed crops:

With the surface water spread across the District, supplementary irrigations could be easily provided by farmers themselves using mobile sprinkler / drip systems for entire rainfed land of about 25 lakh acres in the District. Some calculations have been done by us to arrive at quantity of water required for supplementary irrigation. One TM Cft., of water can command **2.33** lakh acres for supplementary irrigation with a 30 mm wetting. Thus to provide one supplementary irrigation to 25 lakh acres **10.73** TM Cft., of water is needed. A 30 mm. wetting is too luxurious. Generally a 20 mm. wetting is sufficient for closely spaced crops like groundnut, jowar, bajra, foxtail millet etc. For widely spaced crops like red gram or castor for providing row irrigation, they need only about 10000 litres. So with one TM Cft. of water, supplementary irrigation can be given up 10 lakh acres for castor or redgram.

Our rough calculations show that 20 to 25 TM cft of water is needed to fill up all the small & medium water bodies, excluding transmission seepage during distribution of water to the water bodies. Even the transmission seepage would recharge the borewells along side the distribution channel. And an estimated 5 TM cft water on average is anyway received by the water bodies by the normal rain. So, about 20 TMC of water may be needed for filling the water bodies in the District.

3.2.4 Policy imperatives for Conjunctive Water Management:

1. Construction of Farm Ponds with lining must be made compulsory for every 5 acres or less.

2. HNSS project water to be allocated for filling the 3,000 + small and medium water bodies across the District.
3. Anantha Jala Valayam (Anantapur Water Grid) – a water distribution canal network for filling the 3,000 + water bodies has to be constructed together with appropriate intermediate balancing reservoirs at strategic higher locations.
4. Water in all the water bodies should be classified as "Common Property Resource" with rights for use by all farmers for supplementary irrigation of any crop, rainfed or otherwise including tree crops and orchards. And right for use of water by washer men and other rural artisanal livelihoods like pottery etc. be provided.
5. Equipment like Anantha planter, Aqua planter, and Mobile Micro Irrigation system for drip and sprinkler irrigation may be owned and managed by SHGs, VOs, MMS etc., through custom hiring to the farmers.
6. Ground water utilization has to be regulated and made equitably available as much on possible. Water sharing by the bore-well farmers with the neighboring rainfed farmers be made compulsory for supplementary irrigation of rainfed crops during the dry spells.

4 . Conclusion:

The conventional approach to combat droughts is to provide flood irrigation through major irrigation projects. That way one TM cft of water commands 5000 acres of paddy or 10000 acres of Irrigated Dry crops. So the conventional approach is not feasible to combat drought and augment rural livelihoods across Anantapur District. An approach of Conjunctive Water Management, where in the rain moisture is supplemented with surface water, project water and ground water, particularly to bridge the dry spells during the crop season is proposed. This approach will not only combat droughts but also enhance the yields under rainfed conditions by atleast about 50%. It will have a ground-breaking positive impact on rainfed agriculture, irrigated agriculture and other rural livelihoods. The rural livelihoods and the rural economy could be improved substantially leaving behind the agriculture crises, rural distress, droughts and distress migration.