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Millets farming in Anantapur: Social Economic Development of Marginalized Farmers Redefined

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Abstract:- Food security has been very critical in India due to ever-growing population and less productivity and yields. With over 70% people dependence on agriculture, while farming is extremely important but not profitable for majority of the Indian farmers comprise of small and marginalized farmers. With climate change, land degradation, excessive use of fertilizers, and unsustainable ground water levels, marginalized farmers are changing their noble farming profession in becoming daily labor also majority of them are migrating outside of their birthplace. Due to social and economic disparities, especially in women and children, malnutrition is prevalent and widespread with over 20% of kids born in India to people of low socioeconomic status are considered underweight (LBW - Low Birth Weight). This study's first objective is about Anantapur (second worst drought-prone district in India), challenges faced by small, marginalized farmers; second objective brings in how millets can be re-introduced with regenerative farming integrating sheep to support farming and additional source of income, besides income from carbon credits; final objective is to bring good health to marginalized farmers and their families, reduce suicide rates and ultimately financial independence supporting India's ambition of millets farming and climate change.

Keywords:- *Agriculture, ESG, Millets, Sustainable, Regenerative Farming, Carbon Credits, Climate Change, Drought, Farmer Suicide, marginalized.*

I. INTRODUCTION

A. India - Food Safety, Nutrition

In a world burdened with a massive, ever-growing population, the advent of food security has never been more important. India is an agrarian country with around 70% of its people depending directly or indirectly upon agriculture[1]. Although the government of India proposed solutions to increase productivity and yields, it is still uncertain the potential upside for smaller farmers (most of the Indian farmer population)[1].

For small, marginalized farmers, new challenges[1] emerge:

- Growth rates in agriculture have been fluctuating as farming becomes more vulnerable to climate change.
- Land degradation constitutes a major threat to India's food and environmental security and so does rapidly shrinking biodiversity. Large tracts of farmlands in India have become barren due to imbalanced fertilizer/ excessive use of urea.
- About 30 per cent of the 5,723 administrative blocks in the country report that groundwater is at unsustainable levels.

These factors pushed farmers, mostly marginalized, to look for employment elsewhere. Farmers in arid areas couldn't afford to do farming and left their profession, becoming daily labor or migrating towards urban India. This mass migration left millions of acres of arable land to be un-irrigated, causing further degradation. Another challenge faced by Indian farmers is nutrition. Due to social and economic disparities, especially in women and children, malnutrition is prevalent and widespread in marginalized communities. Kader and Perrera at the Department of Public Health Sciences of Karolinska institute's study found that over 20% of kids born in India to people of low socioeconomic status are considered underweight (LBW - Low Birth Weight)[1], and only about 11 percent of children aged 6-23 months received an adequate diet in 2019-20[1]. The recent outbreak of COVID-19 has worsened food supply, impacting the ability of access to affordable foods, further dividing the already existing nutrient deficiencies.

One such case is the district of Anantapur, Andhra Pradesh, India. This continual efflux of farmers, paired with unpromising conditions of agriculture left the district problem-ridden, and its state continuing to decline.

II. ANANTAPUR, ANDHRA PRADESH

More than two-thirds of Anantapur district constituents are into farming while 82% of the farmers are profiled as small/marginal farmers[3]. Small and marginal farmers hold land between 0.55 hectares to 1.47 hectares which represent 65.48% of total land in Anantapur. Historically, most of the marginalized farmers' cultivation practices (mono-cropping, overuse of fertilizers /deforestation etc.) Along with soil environmental conditions (soil erosion and strong winds) lead to a decline in profits. Given most of Anantapur district farming is based on unpredictable monsoon seasons, majority of small-scale farmers are under heavy financial burden and debt, incentivizing them to pursue migrant labor professions

rather than farming to try and achieve financial stability, worsening Anantapur's already dwindling economy.

A. Topography and weather[3],[5],[6]

Anantapur district, under the 'rain-shadow' region due to the prevalence of mountain ranges, is incredibly drought-prone, receiving the second lowest rainfall in all of India. Further, 11 percent of area is classified as 'forest' while the actual forest cover has dwindled to less than 2 percent: Anantapur is the only district whose forests are treeless, with barely around 7 percent of the land in the district irrigated. Even when it receives rainfall, the volume and time periods are random/ unpredictable at best. In some years, the rains have moved from crop to non-crop seasons. For example, there's been a huge downpour in the first 24-48 hours and great dry spells afterwards. Research by the Centre for Study of Science, Technology and Policy (CSTEP) has projected[8] a scenario of warmer summers and winters, 1.5 ºC and 2 ºC respectively along with frequent rain in the next three decades.

B. Soil Quality Limitations:

The soil of Anantapur has limitations in terms of its physical and chemical properties: the coarse texture, shallow depth, poor water-retention capacity, high erodibility of soil due to strong westerly winds; the low–medium organic content, low–medium cation exchange capacity and percent base saturation, high sodicity[5]. These properties make it infeasible for crop growth of any kind along with weather conditions, causing the desertification/ degradation of Land. National Remote Sensing Authority data shows 15 percent of geographical area and 21 percent of cultivable area in the year 1988–89 to be degraded (Reddy, Ratna. 2002)[5]

C. Farming Practices:

Anantapur shifted production to commercial crops like groundnut, leading to a 'borewell epidemic': A report of the National Rainfed Area Authority says there are now "pockets where groundwater exploitation has exceeded 100 per cent."[6] . This groundnut monocropping (est. 69% of all cultivated area) didn't just alter the ground water situation, but vegetation as groundnut requires unobstructed sunlight, prompting deforestation in the surrounding areas. This further worsened soil erosion (mentioned above) and water retention capacities, marking the "shift to rain-fed agriculture difficult." [6]

D. Health Index:

One main disease plaguing Anantapur, largely due to widespread malnutrition, is Anemia. Being heritable, it affects the children lifelong: from the mother's womb to adulthood. 55.8 percent of children, and 50.5% of women diagnosed with anemia in Andhra Pradesh[9]. Lack of financial stability and education leads to underage pregnancies, leaving the children more vulnerable to diseases, worsening health conditions.

E. Farmer Suicides[10], [11],[13]

Unfortunately, predatory debt burdens leave Anantapur farmers financially fickle. 70% of farmers in Andhra Pradesh are in debt, a number higher even higher in Anantapur. Climate change-related agricultural damage, a lack of water for irrigation, a drought, and a weak market for the harvest force Anantapur farmers to take the extreme action of committing suicide, evidenced by the fact that farmer suicide rates rise in dryland regions.

III. MILLETS: A PLAUSIBLE SOLUTION

In summary, Anantapur is plagued with drought, soil quality issues, crop yield, farmer suicides and malnutrition. Addressing these key issues specifically for small, marginalized farmers requires an in-grained sustainable strategy for the long-term to address all these issues.

A. Regenerative/Sustainable Farming

Regenerative Farming is a sustainable farming technique, focused on sustainability and self-conservation, reducing soil erosion, increasing water retention, improving soil health, increasing biodiversity, and more. The concept of sustainable agriculture integrates three main goals - environmental health, economic profitability, and social and economic equity. The concept of sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.

The main tenets of regenerative agriculture are[13]: 1. Improvement and maintenance of the natural landscape and agro-ecosystem; 2. Avoidance of overexploitation and pollution of natural resources; 3. Minimization of the consumption of non-renewable energy resources; 4. Exploitation synergies that exist in a natural ecosystem; 5. Maintenance and improve soil health by stimulating activity or soil organic manures and avoiding harming them with pesticides; 6. Optimum economic returns, with a safe, secure, and healthy working environment; 7. Acknowledgement of the virtues of indigenous know-how and traditional farming system. Regenerating farming is more profitable as input costs are cheaper and locally available.

Sustainable farming strategies help rejuvenate the soil and prepare it for the longer term while also meeting shorter term needs. But what exactly should they cultivate? What crop can withstand the weather conditions (factors we cannot change) of Anantapur? One such crop that fits the criteria is Jowar, also known as millets.

B. Millets Cultivation & applicability for Anantapur District:

Millet cultivation is the main stay of rainfed farming providing livelihood to nearly 50 per cent of workforce in rural areas of India[15]. "Millets as Organic Matter, are slow to break down in soil. "Their slow composting nature helps in maintaining soil structure and retaining water, thus preserving soil health for extended duration"[26]. They may be cultivated on nutrient-poor, salty soils with low rainfall or water, in high temperatures, and are hence ideal for the soil in Anantapur. The research team at the All India Coordinated Research Project on Dryland Agriculture (AICRPDA) proved that cultivation of millets is more profitable than groundnut

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in Anantapur, thus being more economically viable in the long run.

C. Millets as cover crops[15]

control weeds and build soil carbon content. Millets can be grown as food, fodder, source of sugar production, biomass for biofuels, and as a cover crop. Cover Crops also reduce nitrogen leaching, provide high levels of lignin to promote soil-particle binding[15] , and discourage wind and water erosion.

D. Millets and health index

Millets are rich in calcium, iron, zinc, protein, fiber and have a low-glycemic index, possessing rich medicinal properties. In fact, it has been proven to increase mental performance in Indian adolescents[17]. Results from the randomized effect model showed a significant effect ($p < 0.05$) of millet-based diets on mean height (+28.2%) ($n = 8$), weight ($n = 9$) (+26%), mid upper arm circumference ($n = 5$) (+39%) and chest circumference ($n = 5$) (+37%) in comparison to regular rice-based diets over for the period of 3 months to 4.5 years, which was based on largely substituting rice with millets[18].

However, In India, about 70% of the diet is either white refined rice or wheat. Major public health issues like anemia, stunting, diabetes, and obesity are closely tied to this high-carb vitamin deficient diet[18]. Thus, incorporating Millets into Indian diet can mitigate the problems mentioned above. They require fewer synthetic fertilizers and herbicides, and resilience properties[18], thus not being difficult to grow and a low barrier of entry.

E. Millets driving Carbon Credits

Millets have the potential to play a crucial role in future carbon trading, as their cultivation promotes carbon sequestration, resulting in increased carbon credits for farmers and the nation[20]. If India substitutes around 11 per cent of alternative proteins with millets by 2035, India will see a reduction of 0.85 gigatons of CO2 equivalent by 2030[21]. A farmer who sequesters carbon credits is likely to earn from 780 – 2000 rupees, depending on buyer demand and volume. Farmers who follow sustainable farming can sequester 1-4 carbon credits per acre, or about INR 8000 or more per acre from carbon credits trading[22]. This price is expected to increase further, with an ET Report suggest that the demand for carbon credits will rise by 15 times by 2030 creating more demand for credit credits and higher rates for trade[24],

Another benefit of high carbon content in the soil is the increased water-holding capacity, lower soil density, increased water infiltration, increased nutrient availability, and decreased soil surface temperature[26]

F. Integrating animal husbandry (sheep)

Anantapur district represents over 12 percent of sheep in Andhra Pradesh (17.6 million in year 2019, 2nd largest state with sheep population ~ 23.7% of total in India)[27], with sheep population steadily growing at 14 percent year over year in the state of Andhra Pradesh[28] . Along with cultivation of millets, raising sheep with forage yielded even higher income to farmers. Integration of animals such as cows and sheep in drylands reduces input costs such as manual labor/tilling to reduce weeds, potentially alleviating debt burdens[24].

In the recent past, sheep farming increased in rainfed areas[27] of Andhra Pradesh, implying that the district has the sufficient sheep population to meet organic manure demand for arable land in the district.[5]

One field study carried out by Dr. PB Reddy et al.[29] at in the premises of small holder famers to compare growth performances and yields of ram lambs reared under traditional extensive grazing system with that of stall feeding found that after 120 days of feeding, the animals under stall feeding found that the meat productivity of sheep increased by 36% under stall feeding through nutritional intervention by utilizing locally available crop residues as roughage component in complete feed. This study implies the use of local available crop residues could substitute the need of special fodder for the grazing animals, further decreasing theoretical initial input cost.

Besides, Sheep farming is lucrative as sheep have a short maturation span (6-8 months) and can be sold for meat/to other farmers for additional income while feeding on weeds and tilling the soil.

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Table 1: ROI Calculator for integrated millets farming

Return on Investment - Integrated Foxtail Millets Farming/Acre (INR)			
ACTIVITY	**COSTS**	**ACTIVITY**	**INCOME**
Millets Farming[30,31]			
Seeds	500	Millets	
Land Preparation	2,000	Yield of 10 to 12 quintals	
Sowing	400	MSP per quintal @ 3500	
Inter cultural operations	2,300	Total revenue	35,000
Plant protection	1,525		
Natural Fetlizers	1,000		
Misc Acitivities	2,400		
Harvesting and Others	1,500		
Transportation	425		
Subtotal	12,050		
Cost Overrun @ 10%	1,205		
Total Expenses	**13,255**	**Profit from Millets**	**21,745**
Carbon Credits[23]			
4 credits per acre		INR 2,000 per credit	8,000
		Profit from Carbon Credits	**8,000**
Integrated Sheep Farming (4 sheep per acre)			
Per Lamb Costs	2,000	Sheep sale price after 8 months	10,000
Misc Expenses	1,000	Total sheep revenue	40,000
Per lamb total costs	3,000		
Total Expenses (4 lambs)	12,000	Total profit	28,000
		Overall anticipated profit	**57,745**

As observed in Table 1, farmers can increase their income twofold by integrating sheep farming and carbon sequestration. Soil regeneration and water retention practices ultimately make a sustainable environment 'net zero cost'. Incremental revenue streams can be observed by selling fodder, participating in group farming to pool resources, and direct sale to consumers (effectively reducing transport).

IV. CONCLUSION

Our investigation of the district of Anantapur's agricultural situation makes it very evident that agriculture needs further changes. Given that the district's natural environment is not particularly favorable for agricultural expansion, proper interventions are required to maintain and enhance the industry: Adopting integrated regenerative agricultural practices in Anantapur district will bring regenerates soil health, food quality, biodiversity, water recharge/retention; integration of animal husbandry (sheep) and carbon credits as additional sources of income as a part of regenerative agriculture; Cultivation of millets to offset the poor dietary conditions of the farmers. These strategies lead to transition of agricultural from an unprofitable to a profitable and sustainable enterprise, tackling the mass emigration of workers and boosting Anantapur's economy along with the transition of Anantapur itself from dry, arid farmlands to fertile, arable lands.

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