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Causes of Agro-ecological crises related to agronomic practices, Agro-forestry, market price and nature of ecological balance faced by farmers of dryland agro-ecosystem: A critical analysis

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Abstract

Today, agriculture is passing through a difficult phase. Among the many problems that Indian farmers face today, the most important is agro-ecological crises and these crises become a current challenges to agriculture, destroying the very base of agriculture with unsustainable practices, like enormous use of chemicals pesticides, fertilizers, etc. So these crises in farming sector has increased in the last two decades resulting in large tracts of farm lands reporting crisis is due to the adverse condition of environment. The agrarian crisis has started over powering large tracts of drylands. Since this agrarian crisis was due to severe damage caused to agro-ecological conditions of the drylands, this crisis was termed agro-ecological crisis. As these conditions continued to prevail, at regular intervals, over the years a critical analysis of causes of Agro-Ecological Crises Related to Agronomic Practices, Agro-Forestry, Market Price and Nature of Ecological was delineated through focused group discussion, personal interview and factor analysis. An attempt has been made in eight villages of three Mandals in Ananthapur district of Andhra Pradesh to analyse the cause behind the agro-ecological crisis with a sample of 120 farmers selected randomly. The major findings were: Destruction of agro-ecological aspects of crop fields, Neglect of crop residue incorporation in farm fields, Non-supportive and exploitative market prices and market forces, Destabilizing ecological balance in nature. It is the greed and unthoughtful interventions of man that led to destruction of precarious agro-ecosystems in dryland farming systems.

Keywords: Agro-ecological crises, agronomic practices, agro-forestry, market price, nature of ecological balance

Introduction

The planet is facing multiple inter-related crises: economic, financial, energy, agro-ecological and social. Agro-ecological crisis represents only one dimension of the agrarian crises. These crises do not evolve randomly but are a result of a dominant and exploitative capitalist system that promotes economic growth at the expense of people, nature and planet (Altieri, M. A. 2018) [3]. We cannot continue with the same approach, as nature has her own tipping points and boundaries and if these are breached, the whole world is threatened. Indian agriculture is currently passing through a period of severe crisis (Varady RG, & Iles-Shih, M. 2009) [10]. Although some features of the crisis started manifesting themselves in certain parts of India during the late 1980s, the crisis has assumed a serious dimension since the middle of the 1990s. One of the tragic manifestations of the crisis is the large number of suicides committed by the farmers in some parts of India (Kalamkar, S. S., & Shroff, S. 2011) [7]. Agro-ecological crisis occurs when the vulnerabilities of an agro-ecosystem increase and endanger the very sustainability and includes the following dimensions: loss of landscape diversity of vegetation, decline in on-farm crop and animal diversity (number of species), loss of genetic diversity, loss of soil quality and signs of degradation or resource losses due to soil erosion, deforestation, habitat frag-mentation, state of water courses, efficiency in use of water, nutrients, etc., incidence of pests, diseases and weeds, crop damage and dependence on external inputs and ultimately resulting in lower levels of food self-sufficiency. Significant feature of agro-ecological crisis can be observed in declining interactions and bio-resource flows between farm components (recycling of crop residues and manure, effective use of biomass, complementarities between plants, level of natural pest control, etc.) (Altieri, 2002) [4]. The agricultural challenge then, for the coming decades, is to increase food production Substantially and sustainably, using the same arable land base with less water within a

scenario of social unrest and financial crisis (Food and Agriculture Organization of the United Nations (FAO). (2017) [6]. We need to rethink agricultural systems and we need a totally new paradigm. That future agricultural system must be nature-friendly and have low environmental impacts, serve multiple functions, be resilient to climate change and other shocks, and be a foundation for local food systems, including indigenous and local contemporary innovations (Shiva, V. & Bedi, and G. 2002) [9]. Agro ecology is at the heart of all alternative farming systems. It therefore seeks to develop an ecological structure that does not need external inputs and which allows the necessary interaction among species for the system to work (Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M. & Pritchard, R. (2002) [11].

Farmers in the Ananthapur district continue to leave agriculture at an alarming rate with minor exceptions in the last decade. Today, a little more than 70,000 hectares is under cultivation. And most of the crop, apparently, is withering away though the government says crop in only 7,300 acres is under 'stresses. According to official figures, more than 3.4 lakh farmers seem to have left agriculture for good while the quantum of seed distributed has gone down by over 50%, 3.44 lakh quintals to today's 3.32 lakh quintals. From a high of 5.69 lakh quintals being distributed and 6.32 lakh farmers benefiting in 2009, it went to a low of just over 1.24 lakh quintals and 1.39 lakh farmers in 2014. After slowly regaining some ground in 2015 and 2016, backed by the government's promise of farm loan waiver and the ambitious promise of driving away drought by ensuring a successful crop in every acre through a combination of farm ponds and rain guns, the numbers have started to dwindle again. From the dismal lows of 2014, seed distribution rose by 73.98% (year on year) and the number of beneficiaries by 71.75% in 2015. The next year too registered a 43.6% and 37.5% increase in the quantum of seed distributed and beneficiaries respectively. However, it fell to a 7.1% growth (year on year over 2016) to 3.32 lakh quintals seed distributed and registered a negative growth rate of 17.72% in the number of beneficiaries this year. Given the fact that the acreage of alternative crops-castor, cotton and others-including that of perennial crops (mostly horticulture) hasn't crossed the 70,000-hectare mark in any of the past years, it can safely be assumed that well over at least five lakh farmers are not taking to agriculture at all and around five lakh hectares are being left fallow for the better part of the last decade. A through case study have revealed this is happening all because of the agro-ecological crisis faced by the farmers of Ananthapur district (The Hindu, 2017).

Methodology

The study was conducted in dryland agro-ecosystem of Andhra Pradesh. District Ananthapur (Rayalaseema region) is purposively selected as large number of farmers are facing very grave situation in Ananthapur due to agro-ecological crises (The Hindu, 2017). A pilot study was conducted before the actual start of research work to check the availability and time taken by the farmers in this areas (Lancaster GA, Dodd S, Williamson PR (2004). To study the determinants and generalize the findings in this study a critical analysis of causes of agro-ecological crisis was delineated through focused group discussion, personal interview and factor analysis (Bryant, F. B., & Yarnold, P. R. (1995) [5]. The causes of agro-ecological crisis as perceived by farmers was drawn from them through focused group discussion. Then a list is formed and categorized into sets like causes related to erratic rainfall and depleting ground water. Since the pilot study revealed the availability of farmers from the identified list of water sharing groups with the purpose of validating and checking reliability of the schedule developed with the perceived causes and respondent's perception of degree of severity of these listed causes was measured on three-point continuum viz., 'most severe', 'severe' and 'less severe' and given scores of 3, 2, and 1. Farmer respondents were asked to respond to each cause and state their perceived level of severity. Data collected were from 120 farmers analysed with the help of SPSS 20.0 and Excel Stat software to draw valid conclusion. To achieve this, a two-step process was adopted. First the respondents of the study were asked to respond on the perceived severity of the causes agro-ecological crisis, then select the top most important causes (based on the mean values arranged in a descending order) only those were taken which had a mean score of more than 2.5 (out of a maximum score of 3) for factor analysis, which is a data reduction statistical procedure through correlations of correlations. Factor analysis used here to further reduce the number of causes of agro-ecological crisis as a confirmatory approach.

Result and Discussion

Results of Factor analysis of causes of agro-ecological crisis related to Agronomic practices

Among the causes related to agronomic practices, only seven were found to be perceived as more important based on the mean scores of severities of causes, as given in table 1. Only those were taken which had a mean score of more than 2.5 (out of a maximum score of 3) for factor analysis.

Table 1: Mean ranks of severity perceived by farmer respondents on the causes of agro-ecological crisis related to Agronomic Practices

S. No.	Causes related to Agronomic Practices	Mean	SD	More severe	severe	Less severe
1.	Completely not adopting any of the traditional cultural practices	2.95	0.218	114 (95)	6 (5.0)	0 (0.0)
2.	Not being able to efficiently using the crop residue biomass.	2.90	0.301	108 (90.0)	12 (10.0)	0 (0.0)
3.	By growing continuously same crop year after year, agro-ecosystem of the region and its ecological balance in nature gets destroyed beyond repair.	2.86	0.341	104 (86.7)	16 (13.3)-	0 (0.0)
4.	By growing same crops according to farmers' choice (without concern for natural resources) may result in stagnation or decline in crop yields	2.74	0.493	91 (75.8)	28 (23.3)	1 (.8)
5.	Growing high-water demanding crops like sugarcane and paddy, ground water resources get depleted	2.65	0.544	82 (68.3)	34 (28.3)	4 (3.3)
6.	Ground water reserves get depleted by growing commercial cash crops	2.61	0.650	85 (70.8)	24 (20.0)	11 (9.2)
7.	Not being able to go for mulching with the weed grasses pulled out and covering soil to protect soil from heating up losing soil moisture.	2.57	0.720	81 (67.5)	23 (19.2)	16 (13.3)

Now these seven causes related to agronomic properties were factor analyzed and the final factor loadings are given in table 2.

Table 2: Factor loadings of causes related to agronomic practices

Causes related to agronomic practices	Factors	
	1	2
By growing continuously same crop year after year, agro-ecosystem of the region and its ecological balance in nature gets destroyed beyond repair.	0.923	0.03
Not being able to go for mulching with the weed grasses pulled out and covering soil to protect soil from heating up losing soil moisture.	0.944	0.011
Not being able to efficiently using the crop residue biomass.	0.295	0.866
By growing same crops according to farmers' choice (without concern for natural resources) may result in stagnation or decline in crop yields	-0.22	0.896

From among seven, only four have been taken for factor analysis, because these three factors had insignificant eigen values. The results in the table above indicate the high factor loadings on each of the seven causes related to soil fertility. These seven causes were grouped through factor analysis in three factors. Based on the causes (variables) loaded on the factor, a new name is given to each factor. Here for the two factors the following names are given.

Factor 1:	Destruction of agro-ecological aspects of crop fields
Factor 2:	Neglect of crop residue incorporation in farm fields

Under factor 1, two cause-variables have got high factor loadings and two were: first, '*by growing continuously same crop year after year, agro-ecosystem of the region and its ecological balance in nature gets destroyed beyond repair*', and the second, '*not being able to go for mulching with the weed grasses pulled out and covering soil to protect soil from heating up losing soil moisture*'. These two were bad practices in cultivating crops and so this factor is named as '*destruction of agro-ecological aspects of crop fields*'.

Destruction of agro-ecosystem may be the right name to represent these two causes. Due to greed, farmers have been cultivating aggressively the same cash crops every year and exploiting their crop fields excessively without even taking action or giving time for the agro-ecosystem to recover and repair itself. So the agro-ecology of the crop fields get destroyed beyond repair.

In addition, crop residues are being burnt away (causing air pollution) and not incorporating into soils. Farmers have stopped to understand the real worth of crop residue biomass for nurturing micro flora in the soil and for restoring soil structure and soil physical properties beneficial to crop growth.

Under factor 2, two cause-variables have got high factor loadings and two were: first, '*not being able to efficiently using the crop residue biomass*', and the second, '*by growing same crops according to farmers' choice (without concern for natural resources) may result in stagnation or decline in crop yields*'. This factor is given a suitable new name as '*Neglect of crop residue incorporation in farm fields*'.

This factor assumes great significance in the context of agro-ecological principles of recycling wastes into the agro-ecosystem, which enables restoration and recuperation processes of regeneration of the agro-ecosystem.

By nature, farming systems have some in-built mechanisms of interactions and bio-resource flows between farm components (recycling of crop residues and manure, effective use of biomass, complementarities between plants, and level of natural pest control. When this crucial aspect of crop residue incorporation is ignored and neglected, the agro-ecosystems suffer losses and degenerate over a period of time and result in contributing to agro-ecological crisis.

Incorporation of crop residues back into crop fields has its own benefits in the long run. As the organic biomass in the soil gets enticed, the formation of humus and subsequent chemical reactions would help enhance the soil fertility levels especially that of organic carbon content of the soils. With this incorporation, soil micro-flora and fauna would be biologically active in soil and thereby the soil structure is maintained.

Results of Factor analysis of causes of agro-ecological crisis related to other important causes

Among the causes related to other important causes, only five were found to be perceived as more important based on the mean scores of severities of causes, as given in table 4.1.11. Only those were taken which had a mean score of more than 2.5 (out of a maximum score of 3) for factor analysis.

Table 3: Mean ranks of severity perceived by farmer respondents on the other important causes of agro-ecological crisis viz, market prices, agroforestry, nature of ecological balance

S. No.	Other important causes	Mean	SD	More severe	Severe	Less severe
1.	Cutting down trees on the field bunds cutting down trees of forests in the neighboring areas.	2.85	0.358	102 (85.0)	18 (15.0)	0 (0.0)
2.	Reduction in total rainfall due to cutting down and removal of forests	2.95	0.218	114 (95.0)	6 (5.0)	0 (0.0)
3.	The prices at which framers sell their crop produce are not decide by themselves but by the buyers	2.83	0.374	100 (83.3)	20 (16.7)	0 (0.0)
4.	The prices at which farmers buy their inputs for agriculture are decided by the sellers and not by the farmers.	2.83	0.374	100 (83.3)	20 (16.7)	0 (0.0)
5.	Occurrence of imbalance in nature of proportion of harmful and beneficial insects and other animal populations.	2.62	0.675	87 (72.5)	20 (16.7)	13 (10.8)

Now these five other important causes of agro-ecological crisis, were factor analysed and the final factor loadings are given in table 4.1.12.

Table 4: Factor loadings of other important causes of agro-ecological crisis

Other important causes of agro-ecological crisis	Factors	
	1	2
The prices at which farmers sell their crops produce are not decided by themselves but by buyers.	0.916	-0.019
The price at which farmers buy their inputs for agriculture are decided by the sellers and not by themselves	0.906	0.041
Cutting down trees on the field bunds cutting down trees of forests in the neighbouring areas.	-0.226	-0.748
Occurrence of imbalance in nature of proportion of harmful and beneficial insects and other animal populations.	-0.199	0.781

From among five, only four have been taken for factor analysis, because one factors had insignificant Eigen value. The results in the table above indicate the high factor loadings on each of the four other important causes of agro-ecological crisis. These four causes were grouped through factor analysis in three factors. Based on the causes (variables) loaded on the factor, a new name is given to each factor. Here for the two factors the following names are given.

Factor 1:	Non-supportive prices and exploitative market forces
Factor 2:	Destabilizing ecological balance in nature

Under factor 1, two cause-variables have got high factor loadings and two were: first, *'the prices at which farmers sell their crops produce are not decided by themselves but by buyers'*, and the second, *'the price at which farmers buy their inputs for agriculture are decided by the sellers and not by themselves'*. Both of these causes relate to exploitative market forces and so this factor is named as *'non-supportive prices and exploitative market forces'*

This is strange fact that farmers get exploited at both ends. They buy inputs in retail from input dealers and retail shops at high retail prices and not from wholesale markets at cheaper wholesale prices. In the same manner, they get exploited by wholesale merchants and traders in whole sale markets where they go to sell their crop produce. Here too, sellers decide the price at which to buy from farmers. These prices are not supportive and the market forces are highly exploitative. All the struggle that a farmer undergoes to cultivate a good crop facing vagaries of monsoon and sweating in fields goes in vain. This is one of the most important causes of distress among farmers and agro-ecological crisis. The agro-economic sub-system, a part of agro-ecosystem of farmers was perceived as non-supportive and exploitative by these dryland farmers.

Under factor 2, two cause-variables have got high factor loadings and two were: first, *'cutting down trees on the field bunds cutting down trees of forests in the neighbouring areas'* and the second, *'reduction in total rainfall due to cutting down and removal of forests'*. / Both these causes relate to health of agro-ecosystems, especially of agro-forestry and maintaining ecological balance of pests and predators in Nature, especially in agro-ecosystems of crop fields and so this factor is named as *'destabilizing ecological balance in nature'*

Discussion on the results of analysis of causes of agro-ecological crisis

A list of causes was prepared through focused group discussion, categorized into different sets of causes related to conservative agronomic practices and other causes related to adverse market prices, deteriorating agroforestry and agro-ecological balance in Nature. Then farmers' perception of severity of these causes was sought on a three-point continuum of more severe, severe and less severe were analysed. First the causes were screened by deleting the causes which had mean scores less than 2.5 from this most

important causes, two to three factors were derived from each set of causes through factor analysis. These factors were given a new name as the major cause being represented by the causes.

Finally, the major *cause-factors* that emerged were four reduced through factor analysis of 12 causes perceived as *most important* from the initial list of 14 causes collected from focused group discussion. They are:

Factor 1:	Destruction of agro-ecological aspects of crop fields
Factor 2:	Neglect of crop residue incorporation in farm fields
Factor 3:	Non-supportive and exploitative market prices and market forces
Factor 4:	Destabilizing ecological balance in nature

A cursory look into the causes of agro-ecological crisis listed above would reveal that these causes were essentially due to *'man-made errors'* to *Mother Nature* and complete neglect of any pro-active ameliorative measures for recuperative and regenerative farming systems.

Objective

To analyse the causes of agro-ecological crises faced by farmers of dryland agro-ecosystem

Conclusion

It is the greed and unthoughtful interventions of man that led to destruction of precarious agro-ecosystems in dryland farming systems. Complete neglect of pro-active interventions, and untimely actions were not taken have further worsened the situation that the agro-ecosystem got destroyed beyond repair jeopardizing the very survival and livelihoods of dryland farmers and their families. All the causes are again intercalated and further aggravated leading to agro-ecological crisis in dryland agro-ecosystems.

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