

Impact of 2013 Uttarakhand Disaster on the Agricultural Sector- A Case Study Of Trijuginarayan Village, Rudraprayag, Uttarakhand

Akansha Rawat¹

Dr. Madhu Bisht²

ABSTRACT

Climate variability is still a key factor in agricultural production in Uttarakhand. Extreme climatic conditions and frequent natural calamities make the returns from agricultural sector highly unpredictable. Moreover, the calamities also impose heavy economic loss to farming households in terms of loss of current income and destruction of capital assets. This paper seeks to estimate the economic losses borne by the people dependent on the primary sector during and after the 2013 Uttarakhand disaster.

Keywords: Climate Change and Agriculture, Disaster Management

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Author Details:

1. Akansha Rawat is a Research Scholar in the Department of Economics, Doon University
2. Madhu Bisht (Corresponding author) is an Assistant Professor in the Department of Economics, Doon University

I. INTRODUCTION

Natural disasters bring about massive damage to agricultural land that results failure of crops production, causes scarcity of food products, leading to rise in prices and creating turbulences within the economy. Due to devastating effects of the disaster, people were forced to make changes in their cropping pattern with whatever land they were left with. There has been an acute shortage and high demand of milk in households because of loss of livestock and also due to inadequate fodder and grass whose availability has also gone down due to deforestation and shift from traditional crops to cash crops.



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Uttarakhand being a disaster prone state owns a history of occurrences of disaster. Despite the recurring nature of disaster, the state lacks in appropriate disaster preparedness and disaster risk reduction measures. In June 2013 the state was struck with another major natural disaster which was unprecedented, most colossal in the past decade in the Indian history.

The vulnerability of the agricultural sector as a victim of natural hazards need to be taken into consideration because it accounts to massive direct loss in terms of sustainability and employment and also indirect loss in terms of the lost potential income.

In June 2013 the state of Uttarakhand witnessed one of India's most catastrophic natural disasters of the decade. Due to non-stop cloudburst that occurred consecutively for days led to devastating flash floods and massive landslides in the region. The disaster has been termed as the "Himalayan Tsunami". The disaster caused immense loss of property and life. The whole state was a victim of the catastrophe and its repercussions whether in direct terms or indirectly. Out of the thirteen districts in the state, the worst hit were four namely Uttarkashi, Chamoli, Rudraprayag and Pithoragarh. The major loss encountered by the region was that the devastation led the Uttarakhand economy roll back on decades of development and growth posing a severe threat to the economic development thereafter.

A major loss was the loss of land and livestock. The impact of the disaster on the primary sector in general and the agriculture in particular, has been severe. Due to landslides and heavy rainfall either the agricultural lands have been washed away or have been damaged and severely eroded. Since there has been a lot land fragmentation, many farmers in Uttarakhand are small and marginal. In the five most affected districts-Chamoli, Pithoragarh, Rudraprayag, Uttarkashi and Bageshwar, the total cropped area and net sown areas both are adversely affected due to this disaster. The damage to the farm sector comprises the damage due to the washed away lands, damage to agricultural assets, crop losses, and loss due to land siltation. From the detailed assessment report conducted by Uttarakhand Agriculture Department, 2014-15, it was noted that the main damage is through washed away lands. All this has also posed a threat to the food security of the people as well as deficiency of fodder has affected the livestock as well.

II. STUDY OBJECTIVES

The objectives of the study are identified as under.

- To compare pre and post disaster situation on agricultural land loss in in all five most disaster affected districts of Uttarakhand specially in Triyuginarayan village of Rudraprayag district in Uttarakhand
- To compare the given losses in production in the affected areas. .
- To assess the direct loss in terms of Physical and Human capital.
- To assess the direct loss on the agricultural productivity- labor, land and working capital.
- To analyse the well-being of people via agricultural practices-subsistence, commercial and dairy farming.

III. REVIEW OF LITERATURE

The review of the existing literature on the topic and related themes are presented below in different subsections.

Disaster and effect on Agriculture Sector of Developing countries

Many authors have empirically investigated the impacts of natural disaster on the macro economy of a nation. There have been different approaches towards the measurement of the cost/loss in natural disasters (FAO, 2015).

Impacts of floods during non-growing season include loss of top soil, loss of soil nutrients, soil compaction, soil erosion, trees, livestock, and abandonment of farming in floodplains, however impact during the growing season include waterlogging, loss of standing crops, loss of soil nutrients, loss of pasture, erosion, spread of diseases and intermittent interruptions to farm operations. Since flood plains are the areas with highest productivity, people tend to shift to the areas for irrigation and better yield and also the rivers enables them to enhance the agricultural productivity. Lack of systematic compilation of field data adds to the problem of economic loss estimation. Since it is the poor farmers who suffer the largest loss during the natural disasters, it is necessary to study the change in the condition of these poor farmers with limited means (Sivakumar).

The impacts of natural disasters on agriculture can be direct or indirect; positive or negative. Therefore, affected households and areas resulting in ill-effects of natural hazards should not consider only provision of emergency food aid like consumption strategies but also other strategic like provision of wage employment after the disaster. (Danilo C; Hayami & Ruttan, 1970).

Many authors argue that a uniform disaster risk assessment is needed through the use of global data sets. Such datasets may include independent variables such as distribution of hazards, elements at risk and vulnerable factors. Such variables define socio-economic disaster-related outcomes that can be quantitatively calculated globally, identification of hazard and vulnerable components and their damaging characteristics, assessment of disaster on risk on population, infrastructure, and other economic activities at risk, verifying global risk assessment by studying and analyzing some special case studies, and documenting the disaster, vulnerability and risk assessment methods used. To evaluate the risks of two disaster-related indicators namely mortality and economic losses, estimation of the risk levels is prepared from hazard exposure population and gross domestic product (GDP) data for unit area accounted for six major natural hazards like cyclones, drought, earth-quakes, floods, landslides, and volcanic eruptions. A major data source in this regards is from CRED-center for research on epidemiology of disasters. The literature also distinguishes between single hazard hotspots and multi hazard hotspots depending on the whether the level of risk is from a general disaster prone or from any specific types of disasters. If vulnerability and risks are not reduced in countries with high of population or having GDP in those hazard hotspots, they are likely to incur repeated losses and costs related to disasters. (Maxx Dilley; Toya; Debarati Guha).

Study by Mario Miranda and Dmitry V. Vedenov focus on insurances for agricultural risk and innovation in it. Agriculture has always downplayed the importance of insurance as unfavourable natural conditions are not at all



unpredictable for the sector. Rather the disasters become sure events and agricultural income becomes unpredictable. Due to its unsure future income the financial institutions are less reluctant to lend loans because the chances of default are high. Some insurances are available but they have restrictions and in the long term decrease farmers' profit. Natural adverse conditions like drought, floods affect agriculture. Due to the high rate of crop insurance farmers are less willing to take it. The government tried to fund agricultural production but it proved inefficient. The government creates special agencies to cover targeted insurance for local agricultural production by doing partnerships with private insurance companies. Then they form a number of rainfall insurance contracts for different regions and for different crops. The basis risks have three main components which are temporal component, spatial component, and crop-specific component. The problem in index-based insurance is that its design and price are complicated. (Dayal, *Agricultural Productivity in India: A Spatial Analysis*, 1984; Danilo C)

In a developing economy, the changes in the pattern of employment indicated by a fall in the number of agricultural laborers and households is considered good if otherwise the agricultural labour would shift to the less productive jobs or be unemployed. The supply of labour is however much in excess of the demand therefore the wage rate fails to rise resulting in a fall in the number of agricultural labourers. (Ranjan Kumar Som)

With the increase in the scope and awareness of disaster impacts especially in disaster-prone developing countries including India, concern regarding the pre-emptive measures and poor state of preparedness. Since natural disasters create serious hindrances to the development process, therefore the need for systematic data for disaster prevention has been an increasing concern. Inconsistencies, data gaps and vagueness of terms make comparisons and use of data sets difficult. Therefore there is a need for active participation of reinsurance companies in data sharing and exchange, a universally accepted method to evaluate the socio-economic impact and cost of disasters, and an increase in the investment in data quality are of paramount importance. (Debarati Guha)

The predominance and the ability to provide wage goods, agriculture sector is the most important sector where investible surpluses can be generated. It is also pointed out that abundance of wage goods must be provided at low cost in order to raise agricultural productivity and increasing agricultural production is a necessary condition for capital accumulation. While explaining the mechanism of the investible surpluses, the author argues that if the output of the food grains increases, this situation will be prone to relatively lower their prices, thereby creating a surreal situation for the sector. This will serve as a mediator for price inflation. Therefore, it is important and effective to mobilize these resources by channelling them into the non-agricultural sectors. Creation of investible surpluses in agriculture is both easy and less time-taking, however the direct mobilization for productive purposes is difficult. (N.A.Khan)

There is a false dichotomy of agricultural and industrial development because to analyse the role of agriculture sector in the process of economic development it is important to observe the interrelationship between the two. Factually in almost all underdeveloped economies, agriculture is an existing industry of major proportion of the non-agriculture sector also. One important characteristic of this sector is that large quantities of resources namely land and labour. On the contrary to this,

these factors of production are used at very low levels of productivity. It is important to determine agriculture's role in order to maintain a balance between other sectors as well. This can be done through, direct government investment or aids to investment, budget allocation for publically supported research and education extension programs and creating a balance between the burden of taxation levied on different sectors. (Krishna, 2002)

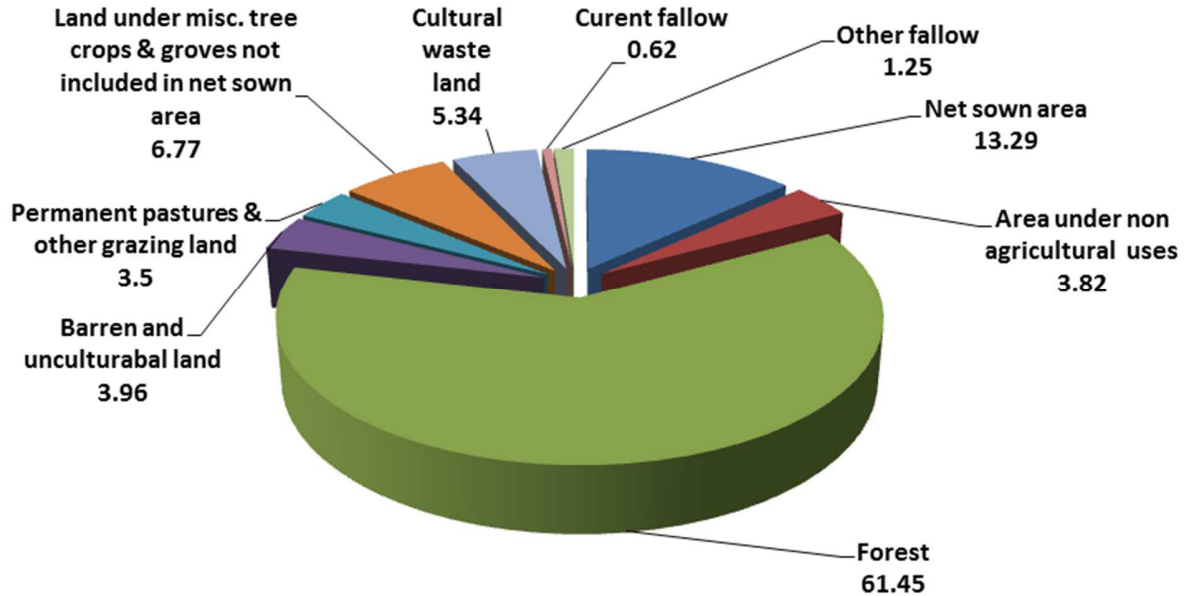
Agricultural output per worker in India is approximately one-fiftieth of that in the US and this has increased in the last decade. However resource endowments, technology as embodied in fixed or working capital and human capital of a country are the major reasons behind productivity differences in different countries. To estimate the cross country production function, the Cobb-Douglas production function has been used because it is easy in manipulation and interpretation. The independent variables used in the study include labor, land, livestock, fertilizer, machinery, education and technical manpower. (Joseph Schmidhuber). There are many studies that focus on agriculture in Uttarakhand in a very generic way, through any discussion on Uttarakhand agriculture cannot be aloof from a discussion on disasters (P.S.Negi, 2014; R. P.Mamgain; Sharma & Dobriyal, 2014; Prakash, 2014). Although these studies provide ideas on various aspects of disaster and agriculture, not much discussion is there on the local issue i.e. linking disaster and the agricultural sector in the state. The present study is trying to bridge that gap by focusing on the impact of Uttarakhand disaster 2013 on the agricultural sector.

IV: AGRICULTURAL PROFILE OF UTTARAKHAND

The Uttarakhand state is endowed with unique ecosystems, the people of Uttarakhand practice integrated systems of farming, forestry, horticulture, livestock and off-farm activities. Five major farming systems are prevalent, namely: (i) cereal-based production system (ii) horticulture based production system, (iii) vegetables, floriculture based production system, (iv) livestock based production system and (v) agri-horti-silvi-pastoral-based production system. Food grains, oil seeds, vegetables, fruits such as apples and livestock produce are the major products. The response of agricultural crop production in different agro-ecological regions to climate change varies according to crop composition, edaphic conditions, and the cropping pattern. A wide range of variation of cultivation over centuries has cumulatively resulted in the preservation of an immense crop genetic diversity in Uttarakhand. But due to climate change, the production has continuously declined and affected the livelihood of the people, therefore the people are migrating from rural to urban area for better life .Uttarakhand is facing the problem of rapid urbanization, for settlement the stakeholders are clearing the forest for multi-storey building, mall etc. in the weak sensitive zone.

As per 2008-09 data, the forest area constitutes almost 65% of the total area of the state. The net sown area for the region is approximately 13.29 % of the total reported area, although there are wide variations in this percentage from district to district. A chart showing the land use pattern in the State is given below.



Figure-1: Land use pattern in Uttarakhand

Source: Compiled from DES Uttarakhand

V. RESEARCH QUESTIONS

1. How the disaster of 2013 in Uttarakhand adversely affected the agricultural cropped land and also initiated shifts in the agricultural practices including subsistence farming, commercial farming and dairy farming? This will be done mainly by collecting of primary data through questionnaires.

2. A cross-sectional and time series analysis will be done to assess the impact of the 2013 disaster on the agricultural productivity of the study area. The micro variables or determinants of productivity that will be used to calculate the agricultural productivity are gross cropped area, the number of farm workers involved in the primary production, working capital.

3. After the occurrence of a disaster the agricultural prices are worst hit thereby leading to changes in the consumption pattern of the households, the research will also adhere to the problems and solution related to the changes in consumption pattern with the help of literature and experience survey and significantly with the help of secondary as well as primary data.

4. After drawing to the conclusions and findings the research will help that what initiative in the form of specific policies and pre-emptive measures, should be taken by the government with respect to the primary sector and its vulnerability to the disaster?

VI. DATA AND SOURCES

The universe of the study is narrowed down to five districts- Uttarkashi, Chamoli, Rudraprayag, Pithoragarh and Bageshwar, based on secondary data which has been collected from different government departments and reports. Further

primary research has been done in Triyuginarayan, a selected village in the Rudraprayag district of Uttarakhand state.

The survey was exploratory in nature as it sought to investigate the views of local people and farmers on such natural disasters and its impact on their livelihood. It was to get an understanding and an insight on how the disaster hit Triyuginarayan village and how it affected the livelihood directly as well as indirectly.

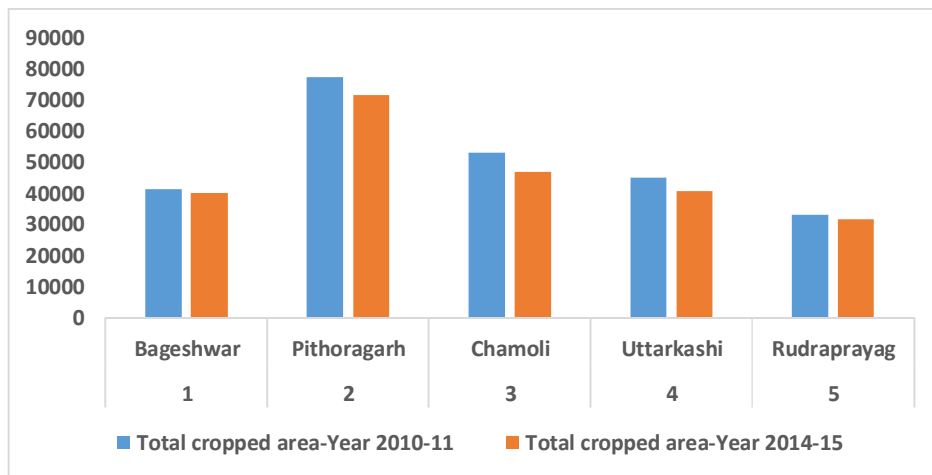
In order to collect the primary data, stratified random sampling techniques have been used to select the sample of thirty households selected from the village Triyuginarayan. This village Triyuginarayan lies in the Ukhimath block of Rudraprayag district. The reason behind the selection of the village was that it was near the Mandakini river zone and also the largest village of the district. The village consists of 236 households and approximately 10 percent of the households were taken as samples of the study.

The questionnaire was constructed with the help of sample questionnaires of other research works related to disaster impact and agriculture. The questions were both open and close ended. The reason behind this type of questioning was the simplification of data analysis. This helped in easy derivation of opinions from a large number of people to certain issues. Secondary data was also collected from various published sources and documents to supplement the primary data. Further, in order to draw the inferences of the study various statistical techniques like mean, graphs, and maps are used in the research. Using descriptive statistics the data was analyzed in terms of frequency distribution and percentage.

VII ANALYSIS AND FINDINGS

A. Analysis based on Secondary Data:

Figure-2 Comparison of Pre and Post Disaster Situation for Total Cropped Area in Five Most Disaster Affected Districts of Uttarakhand

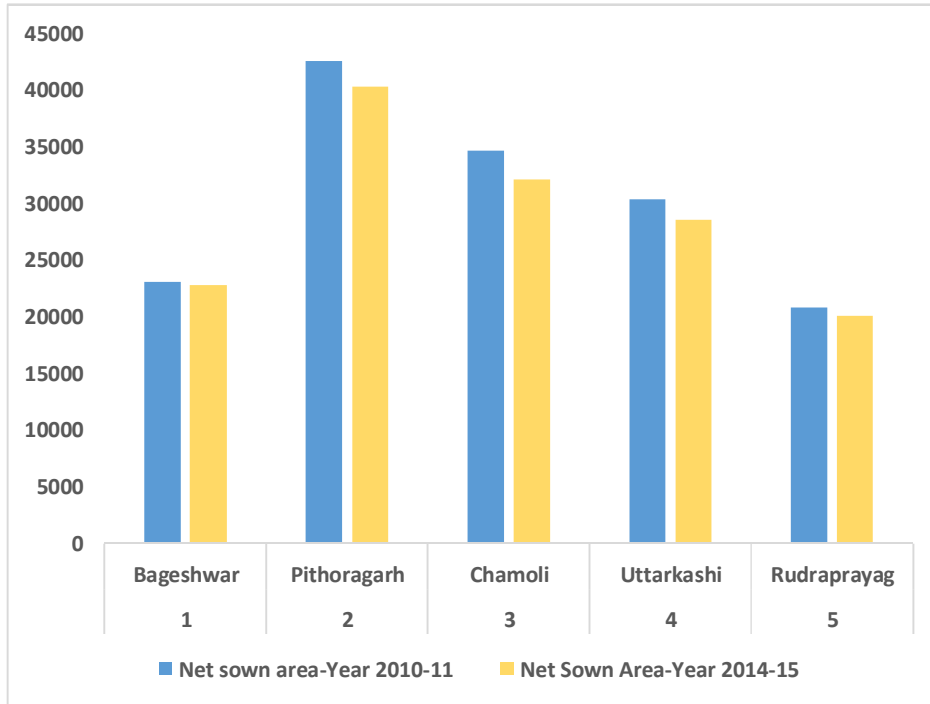


Source: Department of Agriculture, Uttarakhand

Figure-2 and figure-3 show that the Total Crop Area and Net Sown Area both have fallen down in all the five most disaster affected districts of Uttarakhand state after the disaster.



Figure-3: Comparison of Pre and Post Disaster Situation of Net Sown Area in Five Most Disaster Affected Districts of Uttarakhand



Source: Department of Agriculture, Uttarakhand

B. Analysis based on Primary Data:

Trijugarayan village is located at an altitude of 1980 metres about 5 kilometres from Sonprayag, the confluence of Mandakini and Songanaga rivers. The village has favourable agro-climatic conditions for growing horticulture crops and the vegetation of potato and rajma. The village has a famous temple that resembles the temple of Kedarnath in architectural style and therefore magnets many tourists. The main sources of income are agriculture and tourism only.

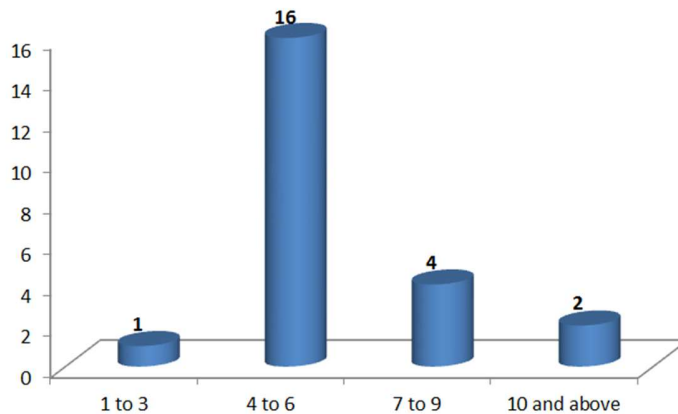
Table-1: Occupation Structure of the Households in the Village

OCCUPATION	Male	Female	Total	Percentage
Service	4	0	4	3.3
Self employed	13	0	13	10.7
Farmer	7	25	32	26.4
Labour	4	0	4	3.3
Student	26	15	41	33.9
Retired/pension holder	2	0	2	1.7
Unemployed	5	1	6	5.0
Dependents	4	15	19	15.7
Total	65	56	121	100.0

This part of the study is devoted to socio-economic characteristics of the respondents, effects of disaster- pre and post disaster situation, response to the disaster situations and government role, based on the results of field survey. The major characteristics such as age, size of the family, monthly income, loss due to disaster etc are discussed and analysed in this village.

As we can see from table-1, majority of the people, that is, 26.4 percent are engaged in as farmers, with maximum women participation. Therefore the inference can be drawn that the main occupation is farming followed by self-employment where women participation is zero.

Figure-4: Size of the Family



Size of the family plays an important role to know about the socio-economic condition of the respondents. As depicted in the figure that the majority of the size of family lies between four to six members.

In most of the hilly region the landholdings are small and scattered. The land details of the respondents are important because they indicate the economic and social status of the household. The above pie chart shows that the majority of the people have land upto 100000 INR. It was found that the land measurement is done in terms of Nali. The rate of Nali differs on the basis of its location on the terraces i.e a land on the top most hills and downhill was less in rate and the ones on the middle terraces were relatively high in rate.

During the field survey it was found and depicted in the above figure that the maximum direct loss borne was the washed away agricultural land due to massive rainfall and landslides, followed by loss of infrastructure, loss of livestock, assets loss and life loss.

Figure-7 shows the lost amount of crops that were sown at the time of disaster. The crops chosen are the main ones. The maximum amount lost in the disaster was that of *mandua*, a staple food in the hilly regions about 650 kilograms, potato accounting for 400 kilograms, *ramdana* which is a type of green vegetable and then finally wheat. This lost amount of crops can also be considered as the loss of potential income as farmers sow the crops for self-consumption and for commercial purpose, therefore loss of the yield has resulted in loss of income either ways.

Figure-5: Land Holdings Structure as per the total value of land owned in Trijuginarayan Village

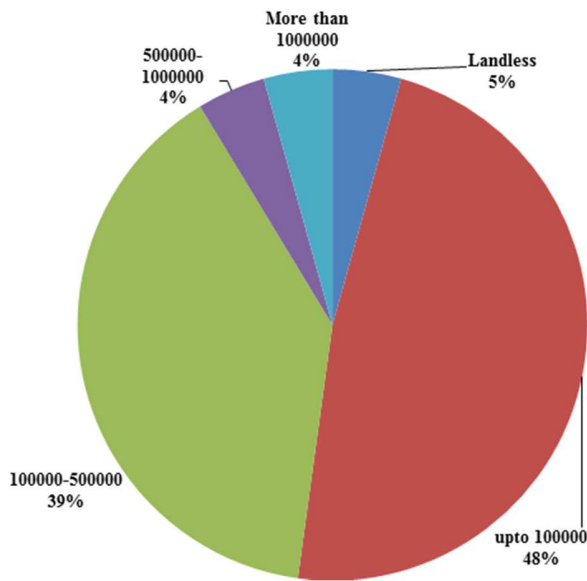


Figure-6: Loss in terms of Human and Physical capital

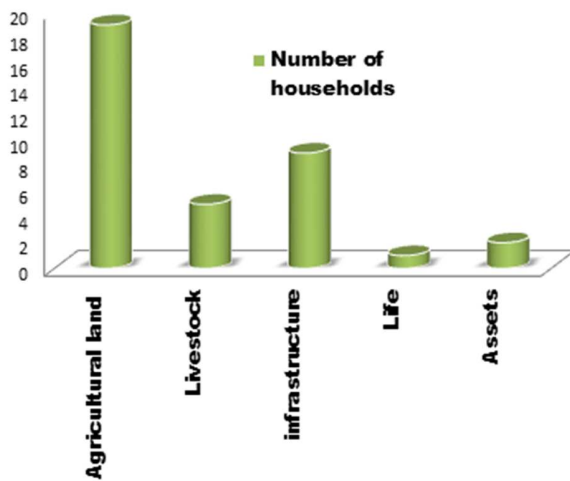


Figure-7: Loss of Production

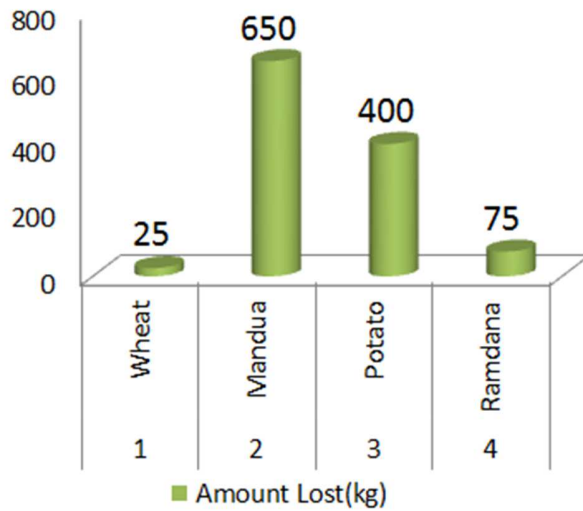
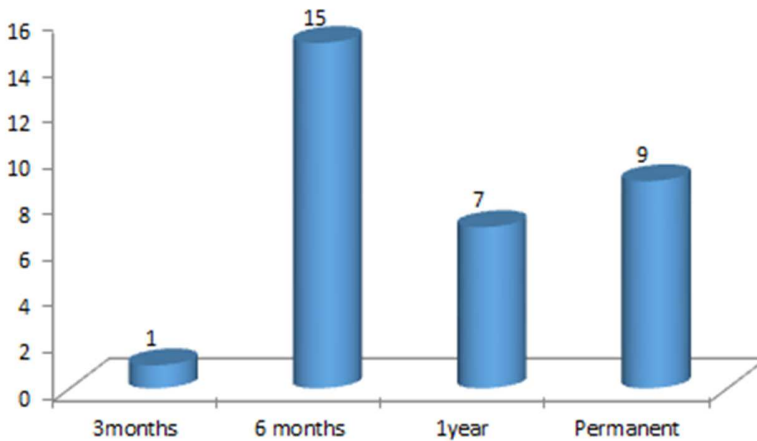


Figure-8: Loss of Employment (Number of persons in village)



The above figure-8 shows that out of the twenty three households, maximum number of people lost their income for six months and many remained unemployed for one whole year. It is also noted that out of the total twenty three randomly selected households, nine people had permanently shifted their occupation from farming for reasons like loss of agricultural lands, livestock, uncertainty attached to the sector and insufficient returns.

The above table shows the role of the government in helping the interests of the farmers and other villagers, during and after disaster. It is seen that no person has been compensated for the loss of their agricultural land or even for the repairment purpose. No compensations was provided by the government for the loss of livestock which included loss of horses and mules that were employed in



the Kedarnath and was the main source of income for them and also for the loss of oxen that were one of the important capital used for ploughing in the land for farming purpose.

Table-2: Government Role

	Received Support	No Support
Reimbursement for loss of land	0	23
Reimbursement for loss of livestock	0	0
Reimbursement for loss of life	1	0
Gain in employment	8	15
Gain from government programme other than relief	8	15

Source-Field Survey

There was one family out of the twenty three surveyed, who lost life of one of their family members, and government compensated for the loss in monetary terms by paying seven lakhs. There was gain in employment about 55% through the Mahatma Gandhi National Rural Employment. Almost everyone received short-term assistance from the government during the disaster.

VIII. LIMITATIONS OF THE STUDY

The universe of the secondary study is confined to five most disaster affected districts of Uttarakhand and Triyuginarayan village, district Rudraprayag of Uttarakhand state for primary study.

The study is mainly based on the primarily data. However secondary data were also to supplement the primary data.

The study is confined to investigate the impact of the 2013 disaster on the primary sector of the selected study area.

IX. CONCLUSION AND FINDINGS

With the help of secondary and primary data, some inferences can be drawn. There has been a drastic change in the production, distribution and consumption process of the agriculture sector.

A. Conclusion based on Secondary Data

In the first strata where secondary data and their graphs have been used, we conclude that after comparing the pre and post disaster situation, it was found that Uttarakhand disaster 2013 adversely affected the growth of agriculture sector through loss in production by destroying the agricultural land, disturbing the entire production cycle, change in the existing cropping pattern, loss of useful agricultural assets, means of livestock and infrastructure, disrupting the flow of trade and income loss in all affected areas.

It is a universally known fact that agriculture production is the backbone of the economy and falling down of the total cropped area is a disadvantage for the State

especially because the agricultural sector is interlinked with many other sectors. There is a special significance of these variables in any agrarian economy. An analysis on the basis of total cropped area, net sown area has been done through graphical representations. From figure-2 and figure-3, it was observed that the Total Crop Area and Net Sown Area both have fallen down after the disaster. So, there is a need to increase the net sown area for meeting the growing food demand with the increasing population.

B. Conclusions based on Primary Data

In the second strata of the study, a primary research has been conducted with the help of questionnaires and personal interviews.

During the survey many unreported facts came into light. The study shows that most of the population of the villages fall under the youth category are males. Most of the people are found to be students which is a good sign signifying the fact that people are sending their children for education without any gender discrimination. Next it was found that most of the people that are employed are farmers, wherein the females outnumber the males. 10.74% of total persons, where the female participation is zero, are self-employed. This indicated that due to the frequency of disasters, people have switched to a more stable and relatively predictable source of income. There has been an increment in land fragmentation as a result of traditional social responsibilities and washing away of lands in the disaster. This has resulted in the landholdings to be small and scattered specially in the hilly regions. During the survey, it was found that the land measurement is done in terms of *Nali*. The rate of *Nali* differs on the basis of its location on the terraces like for example a land on the top most hills and downhill was less in rate and the ones on the middle terraces were relatively high in rate. However according to the *pradhan* of the village and most villagers agreeing upon it, said that the left over fields have huge holes in them and only mud is left, due to all these problems it has taken years for the farmers to recover their field's fertility.

Through the study it was estimated that the maximum loss was borne by the primary sector via Agricultural land loss, loss of production and livestock, infrastructure which included mostly cowsheds and agricultural capital. There are many other costs and effects allied to these macro loses. All these losses are quite direct however they result in changes in the economic flows like there is definite loss of production after these losses, there are higher costs of raw materials and inputs to recover, there is increased operational costs and lower returns.

In order to estimate the loss of potential income, the amount of sown crops that were lost during the disaster was calculated from each of the twenty three households. Collectively it was noted that the maximum lost crop was the production of *mandua* which is the staple food in the hills. The main crops the farmers sow in the village are *mandua*, wheat, *jaun*, *sarson* (mustard), *rajma* and potato. Vegetation of fruits and non-green vegetables is almost negligible here. The other crops were also sown like wheat, potato and green vegetables. This can be concluded as the loss of direct as well as potential income.

The village is affected due to various reasons-one agricultural loss and second, the loss in tourists arrival. This has adversely affected the livelihood of the ancillary shops and small businesses, the mule owners and many other small business present there. One more reason is that after the disaster the villagers have suffered changes in the cropping pattern. This village was famous for the production of potato, and *rajma* however after the disaster there has been a



considerable fall in the production activity. Also this village used to produce wheat and rice but after 2013 the production of rice completely shifted to production of *jaun* which probably belongs to the rice family and is used for fodder purposes. Although the village did not experience massive property loss but during the disaster the farmlands that were already fragmented, further broke down into more terraces, leaving extremely small terraces of farms and according to the villagers, was one of the most important reasons for the fall in production and changes in crop pattern. Another new revelation that came across was that the women were self-reliant as they used to sell cow milk, wooden blocks, and grass to Gaurikund but after the disaster it all fell apart.

It has also been observed that there has been a temporary and permanent loss of agricultural employment. Most of the farmers were left unemployed for six months. The village is characterized by people (males) working for six months as farmers and hoarding the produce and work six months as providing different services in the Kedarnath shrine. It is rather a dismay to notice that out of the 23 households, 9 people had shifted their occupation from farming to any other occupation. The reasons that were given were that loss of land, soil fertility, low revenues, uncertainty attached to this sector.

As the study suggests there has been a considerable loss of working capital, the recovery for which has been difficult ever since. The use of this capital is essential for not only the production purpose but also for the efficiency of the production.

Since there has been a loss of agricultural land, loss of employment of farmers (temporary as well as permanent) and loss of working capital by the formula – Agricultural Productivity=f(Agricultural Land, Labour, Working Capital) + u

It can be concluded that the disaster 2013 that occurred in the state has resulted in the fall of agricultural productivity. The term 'u' included certain other factors responsible for the fall in the productivity which included, destruction of fields and crops by wild animals,

This disaster has set the development clock of the State back by decade. Due to lack of village-wise and district-wise data, the production in the year 2015 has been used to show the changes in consumption pattern of the people and the changes in agricultural practices. During interviews, a notable fact came into light that as the years are passing, the production of all the crops has fallen considerably. Earlier the village was famous for its marketing of quintals of potato, *rajma* and mustard. In the rural areas, the people produce to fulfil their subsistence needs and the rest for marketing purposes. But during the survey, it was determined that the production has fallen so low that the villagers have switched to the buying of the basic food needs and selling the produce for the purpose of earning money. It is concluded that earlier the yield was enough for subsistence as well as commercial farming but through primary research it was noted that a tremendous change has affected the agricultural practices. It has been observed empirically that the seasonal rainfall pattern has been disturbed greatly in the past few years. Winters are going almost dry, without significant rainfall. The big picture here is that the farmer is at loss from two sides, one that climate and weather that determine food security and production and second that the farmer from the point of view of the consumer because he is also dependent on agriculture for his subsistence needs.

This whole process has affected the well-being of the people because it has made adverse variations in their consumption expenditures. Further as a result of this alteration, the agricultural prices have hit, thereby making changes in the agricultural trade flows. Due to devastating effects of the disaster farmers are forced to make changes in their cropping pattern with whatever land they were left with. There has been an acute shortage and high demand of milk in households because of loss of lakhs of livestock and also due to inadequate fodder and grass. The availability of fodder and grass has also gone down due to deforestation and shift from traditional crops to cash crops. The existence of agricultural small scale and cottage industries in the mountain regions is relatively very high than that of large scale projects. These industries or small scale farmers, herders, and forest reliant communities are particularly at risk from these disasters that destroy harvest, supplies, livestock, seeds, yield, crops and stored food.

During the disaster and till few days later, the government constantly supplied relief for every household. The relief included food supplies, fodder, and utensils. The central and state government have released a number of schemes in order to encourage the farmers and protect their interest, through various schemes include Jawahar Rojgar Yojana(JRY), Swarna Jayanti Shahri Rojgar Yojana, (SJSRY), Training of Rural Youth for Self Employment(TRYSEM), Pradhan Mantri's Gramodaya Yojana(PMGY), Indira Awas Yojna etc, Most of them are successfully implemented and have yielded good results but it was noted that people in the study regions are deprived of these policies. It is due to the lack of proper knowledge about the government policies and loopholes on the part of the government that these well thought schemes including unemployment schemes are not properly executed. However according to the respondents' only MGNAREGA scheme is functional in the village and the other adjacent villages. There was an employment for an average of twenty one days for each person.

The study also reveals that every household had either lost their agricultural land or had incurred severe damage to it. However no household whatsoever received any compensation for the lost/damaged land or even for the loss of crops which as discussed earlier was the lost potential income.

X. RECOMMENDATIONS

- The assessment of the effects of the global climate change and prediction of the disasters in the relevant areas on the primary sector might help to deal with the farming system and maximize the agriculture production.
- Since the farmers work on a half yearly basis and hoard the rest of the produce for the rest of the six months for either subsistence or commercial purpose, they must be provided with strong infrastructure. The warehouses must be built considering the unpredictable conditions and also be accessible for the farmers. This way there will be efficient utilization of the resources as well.
- Pre-emptive measures for this sector against erratic weather conditions
- Crop and farmer insurance against agricultural risk and externality
- Green GDP- This GDP is the index of economic growth with respect to the environment; it is the residual GDP after subtracting cost of pollution and depletion of natural resources from traditional GDP. The green GDP takes into account and monetizes the costs caused by climate change and the loss of biodiversity. Since farmers are directly related to these qualitative factors, it would directly go into the favour basket of the welfare of farmers. Another



contributing factor is that green GDP will also account the related externalities which are otherwise left unaccounted for thereby posing a loss for the farmer.

- The government compensated a few farmers in the year of 2013 for the loss of land. But from an economist point of view, here the problem that is intense is the indirect loss associated and that no compensation related to the potential income is provided which definitely is a major loss.
- To maintain the crop yield through sustainable agricultural practices, it should be considered to promote organic farming methods, combining modern technology with traditional farming practices. Government should provide incentives for organic manures, vermicomposting and green manures at household level and village level.
- The result of this change is that the income distribution of the farmers has increased in terms of food. However another loophole associated with this problem is that the policies need to be revised because earlier the policies were related to price ceiling and minimum support price with respect to the earlier situation.
- The unidentified occupational structure of the farmers has posed a hurdle on the other side of the coin i.e. the side of the planning authorities Often it is also noted that the most of the women and children are also engaged in the agricultural field which is usually regarded as disguised unemployment, also a landless farmer is not included in the workforce. In order to make considerable welfare in the hegemony of farmers these things must be kept under consideration with special focus on marginal and landless farmers.
- Many farmers, especially in the remote areas where passing of information is not easily accessible, do not have the most updated information. Information can be related to weather forecasts and measures against these odds, how to produce products efficiently and economically, knowledge about new techniques and technologies, all these and allied information is important for a farmers' production level. Since education and symmetric information among the farmers is directly related to their welfare, special attention must be showered in this area.
- Chemical fertilizers are posing a threat to the land as well and water bodies, incentives for organic manures, vermicomposting and green manures at household level and village level.
- Traditional resilient crops like millets (Jhangora, Mandua), pulses (Tor, Aorangi), oilseeds (Till, Jacky,) which the state is famous for, and the pragmatic approach and importance of the 175 rare species of the aromatic plants, must be promoted on a large platform. Promotion of such rare features will be beneficial ifor the Uttarakhand economy in many ways.
- Government should protect them from wild animal's destruction and loss of property and encroachment of the villages and farms, and the establishment of farmer market must be set up at village level. Embankments should be made where the land is depleted along the river.
- Adaptation capabilities associated with food production system should be enhanced through strengthening agriculture, forest, livestock linkages and farmer's knowledge, innovations and strategies. Adapting to the disturbed and erratic weather conditions, farmers have started cultivation of crop varieties that require the available resources. Special focus and encouragement must be done to adaptation capabilities associated with food production system

should be enhanced through strengthening agriculture, forest, livestock linkages and farmer's knowledge, innovations and strategies.

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