International Research Journal of Human Resource and Social Sciences
ISSN(O): (2349-4085) ISSN(P): (2394-4218)
Impact Factor 5.414 Volume 7 Issue 10, October 2020
Website- www.aarf.asia, **Email** : editoraarf@gmail.com

ECONOMIC ANALYSIS OF CLIMATE CHANGE IMPACT, ADAPTATION AND MITIGATION ON KINNOW (SANTRA) FARMING IN INDIA WITH SPECIAL REFERENCE TO WESTERN U.P. DISTRICT

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Abstract

This study's objective is to explore the economic consequences that climate change will have on the cultivation of Kinnow (Santra), as well as the techniques of adaptation that farmers will employ and the effectiveness of the measures that will be implemented to mitigate the effects of climate change for the aim of mitigating the effects of climate change. The effects of climate change are causing significant challenges for the agricultural sector, especially in regions that are economically dependent on certain products, such as crops. Kinnow (Santra) farming in Western Uttar Pradesh, which is distinguished by its one-of-a-kind agroclimatic conditions, is very vulnerable to variations in temperature, patterns of precipitation, and especially severe weather events. This is because of the unique agroclimatic conditions that dominate the region. A number of factors, including crop yields, fruit quality, and overall productivity, may be impacted as a consequence of these changes. For the purpose of this investigation, the researchers used a mixed-methods approach, conducting an analysis of both quantitative data and qualitative material obtained via interviews and focus groups with farmers. An examination of historical climate data, as well as records of agricultural yields and market prices, will be carried out as part of the economic impact assessment. This will allow for the monetary consequences of climate variability to be quantified. A cost-benefit analysis will also be used to evaluate the various choices for adaptation and mitigation, with the goal of determining whether or not they are economically feasible and sustainable over the long run.

Keyword: *- Climate change, Kinnow (Santra), Smallholder farmers, agricultural.*

INTRODUCTION

The production of food has been the primary economic activity for human beings for an uncountable number of years. Agriculture, as well as the industries that provide support for it, is of critical significance to the economy of India. Horticulture is a component of India's agricultural industry, which is experiencing significant development and is responsible for 28 percent of the country's gross domestic product. Horticulture is responsible for the rise of the agricultural sector. The way that customers think and act is connected to horticulture, and there is a link between the two processes. More and more people are shifting their focus away from food grains and toward horticulture goods for a variety of reasons. This shift is occurring for a number of different causes. Furthermore, as a result of this, the horticulture industry is increasing its relevance to the agricultural sector in general and to our economy in particular. Agriculture is responsible for more than 28 percent of India's gross domestic product, and during the fiscal year 2013–2014, it was responsible for 52 percent of the entire export income that the nation received. In the United States, the cultivation of fruits and vegetables takes up 11.35 percent of the total cultivated area inside the country.

These crops are responsible for producing close to 90 percent of the world's fruit and vegetable harvest. When the nature of fruits and vegetables is taken into consideration, it is not easy to judge the quality of their production. It is difficult to analyze various items, especially vegetables, since they are often grown in small areas, fields, or even people's backyards. This makes it difficult to evaluate the products because there is no single harvesting. From one season to the next, there are several harvests of a variety of fruits and vegetables. A comparable point to consider is that the distributed fruit trees do not make a contribution to the assessment.

We are the second-largest producer of fruits and vegetables in the world, thus it is in our best interest to ensure that our clients are satisfied with our products. Fruits from India are exported to nations all over the globe, and they come in a broad variety. Grapes are the products that are exported the most, with 188.2 thousand tons being sold for a price of Rs. 1, 89,994.86 lakhs. Bananas and mangoes are two more fruits that have become into substantial commodities available for export. A growing number of fresh vegetables, such as potatoes, onions, and peas, are being sent out via international trade.

The development of horticultural gardening is a reflection of the growing demand for fruits and vegetables, which has been occurring in recent years. A positive effect of previous experiences has been an improvement in the output that is derived from the inputs. The availability of timely and insightful information in the field of horticultural agriculture would unquestionably lead to an improvement in the economic situations of the people living in India. This would result in the provision of self-sufficiency in addition to the advantages gained for the environment. The nation's attitude about fruits and vegetables has gone from pessimistic to hopeful. As of right now, 33 percent of total agricultural production is comprised of produce derived from fruits and vegetables. All of these activities are within the scope of agricultural and associated activities. The proportion of money given for production increased from 3.9% in the IX Plan to 4.6% in the current plan, which is all under the purview of agriculture.

Over the course of the last few years, India has seen an increase in the amount of fruits and vegetables that it produces. For the purpose of achieving high production, the emphasis has switched to expanding in regions that have already shown greater yield. During the course of the last ten years, the annual output of horticulture as well as the area under cultivation have both increased at a pace of 2.6% and 4.8%, respectively. The amount of fruits and vegetables that were produced in 2017–18 reached 311.71 million tons, and they were grown over an area that was 25.43 million hectares. The production of vegetables increased from 101.2 million metric tons to 184.40 million metric tons during the years 2004–2005 and 2017–18, while the production of fruits increased from 50.9 million metric tons to 97.35 million metric tons compared to the previous year. With a total production of 392.48 lakh metric tons of fruits and vegetables in 2017–18, Uttar Pradesh was the state that produced the largest overall quantity of these items. West Bengal came in second with 324.2 lakh metric tons. The state of Andhra Pradesh is the one that produces the most fruits of any other state, with 152.15 lakh metric tons. The state of Maharashtra comes in second with 117.28 lakh metric tons.

As a member of the Rutaceae family, the Mandarin Kinnow (Santra), also known as Citrus reticulata, is an important fruit crop due to the large amount of vitamin "C" that it contains. A total of 7.9 million hectares are used for agricultural purposes around the globe, which results in an estimated 3.84 million metric tons of fruit consumption. India is ranked tenth among the top nations that produce Kinnow (Santra), and it is responsible for three percent of the total fruit production anywhere in the globe. Many states in India, including West Bengal, Punjab, Madhya Pradesh, Maharashtra, Rajasthan, Assam, and Karnataka, are responsible for the production of a significant quantity of Kinnow (Santra)s. India is responsible for the production of 3,431 million tons of rice, with a total area under Kinnow (Santra) that is 330,000 hectares and a yield of 10.4 metric tons per hectare. Punjab is by far the most significant of all the states that are responsible for the production of Kinnow (Santra). The most productive region for the cultivation of Kinnow (Santra) fruit is Maharashtra, which has an area of 105.47 thousand hectares and produces 716.07 million tons of the fruit.

OBJECTIVE

1. The research focuses on adapting and mitigating Kinnow (Santra) farming in western up district, India.
2. Assess historical climatic data and trends in Western Uttar Pradesh.

Methodology

The purpose of this study is to investigate the impact that climate change might have on the profitability of the production of Kinnow (Santra) in western Uttar Pradesh by using a diversified approach. A large amount of information is gathered from a wide range of sources during the first phases of the process. This information includes records of the climate, records of agricultural output, and economic indicators such as market price and production costs. By conducting interviews and surveys with farmers, one may get insight into the strategies and challenges associated with local adaptation. Data analysis includes trend and correlation studies, which are used to examine the impacts of climate change on agricultural output and monetary losses. A further examination of the economic feasibility is carried out by means of cost-benefit analyses of various adaptation and mitigation strategies, such as the use of resilient crop varieties and environmentally responsible agricultural practices. In the last portion of the report, there are policy ideas that are included to increase the ability of Kinnow (Santra) farming to endure and adapt to changing climatic circumstances.

Agricultural harvesting is rendered impossible at the first location due to the dam filling up during the wet season. Seepage and farmers' usage of water for winter crops cause the pond's water level to drop dramatically after a rainstorm. The upper level of the pond is mostly dry by the end of October, with only the deeper sections remaining wet. The moment to sow rabi has come. Because the water is used for agricultural irrigation by local farmers, the deeper parts of the pond are ideal for farming, thereby creating additional room for agriculture. Many farmers utilize the dam to cultivate a variety of crops when the water supply is low or nearly emptied, which is usually around December. Growing Kinnow (Santra) , a fruit with a short harvest window, could be a way for local farmers to autonomously adapt and transform adversity into opportunity. Agroecology knowledge is utilized for this purpose. Plowing twice is the initial stage in preparing a field for adaptation. Soil compaction can be reduced, clods broken up, and optimal soil tilth achieved. For soil tillage to be effective, crop stand, growth, and yield must be satisfactory. Lighter soils are more easily washed away by wind and water after being over-tillered. Saxena et al. (1997) found that using less tillage results in time and energy savings, reduced soil moisture loss, preserved soil structure, and increased cropping intensity. Sowing native KAJRI musk melon seeds follows treatment.

The farmer prepared ditches four to six cm deep and spaced the plants 1.5 feet apart in rows six feet apart. Each hole is prepared by planting four or six treated seeds, covering them with sand, and then harvesting them. Early on, the farmer would protect the seedlings from drying out by covering them with Crotalaria burhia and Leptadenia pyrotechnica, two plants that are readily available in the area. After around five or six days of seed germination, this takes place. Through the utilization of organic matter in runoff and retained moisture, these seeds offer rapid germination, lush development, and an abundant harvest. When the plant reaches a height of 10-15 cm, carefully work the soil. This keeps the soil from drying up during plowing and prevents sucking insects from hiding their eggs in the dirt. With this technique, row plants can cover one other to retain moisture and develop lushly. This allows plants to reach their maximum potential (seen in Fig. 1 as a result of gradual conservation). Kinnow (Santra) s can't be grown without the help of family workers and daily wage laborers who work for landowners.

At the second location, agroecological methods are used (AMHI)

The second site field was prepared for seed planting using standard tilling, which began at the start of February. Applying the appropriate amount of fertilizer is crucial for a successful final leveling. Plant spacing was set at 30 cm between plants in two-row beds that were two meters wide for the purpose of seed planting. A distance of 120 cm separated the rows. Each location has an annual seed-planting ceremony in the middle of February. At a depth of one to two cm, one seed was scattered throughout each hill. Prior to sowing, a pesticide called furadon (carbofuron) was used at a rate of 5 kg per hectare to protect the seedbed from insects, specifically the red pumpkin beetle. Seven to ten days passed before the seeds germinated, and thirty to thirty-five days later, seven to ten times in succession, a preventative spray of Mancozeb 75% W.P. at 1250g/ha was administered. To make sure the seeds would grow, this was done. In order to keep the soil moist, irrigation was done in furrows as needed, usually once every ten days. In addition to keeping a close eye on the development, we were also searching for signs of disease and enhancing our methods of crop management.

We found that the following data points were documented: vine length in meters, leaf count per vine, days to first bloom, days to first harvest, fruit count per vine, fruit weight in grams, fruit yield per vine in kilograms, and fruit yield per hectare. The cost of cultivation and the price of fruit during that time were considered for the aim of determining the economics. Five Kinnow (Santra) plants and average-sized melons were chosen for each region in 2017, 2018, and 2019. To find the benefit-cost ratio (B:C), divide the absolute net return by the cultivation expenditures each day. Then, divide the total net return by the total net return each day, up to the length of the crop, to find the daily productivity (in kilograms per hectare) and total yield (in rupees per hectare).

Result and Discussion

We compare Kinnow (Santra) s grown using conserved moisture and low inputs (CMLI) to those grown using all the necessary inputs, including high inputs and suitable irrigation. In this research, we compare. The study found that growth metrics, blooming behavior, yield parameters, and yield output were all impacted by irrigation management systems with input levels. Over the course of the three years, the average value of the Kinnow (Santra) s crop growth factors varied from 1.78 m to 2.18 m, depending on the cultivation setting. A combination of factors, including sufficient irrigation and heavy inputs like fertilizers, plant protection, and excessive plowing, contributed to this. This disparity is shown to be statistically significant in Table 1.

Table 1 Impact of agronomic management techniques on Kinnow (Santra) growth parameters: Conserved moisture with low input (CMLI) and Adequate irrigation with high input (AMHI)

Agronomy management Practiees	Vine length (m)				The quantity of leaves on a vine				Days till first bloom (DAS)				Days until the first female bloom (DAS)			
	2017	2018	2019	Mean	2017	2018	2019	Mean	2017	2018	2019	Mean	2017	2018	2019	Mean
CMLI	1.70	1.82	1.82	1.78	70.4	69.4	67.9	69.2	30.2	29.8	29.2	29.7	34.1	34.3	34.0	34.1
AMHI	208	2.13	2.32	2.18	79.9	79.7	80.4	80.0	35.0	35.6	35.6	35.4	39.7	40.2	40.0	40.0
C.D.	0.25	0.13	0.16	0.15	62	43	5.3	4.8	21	1.7	1.5	1.4	21	1.4	1.6	1.4
SE(m)	0.08	0.04	0.05	0.05	1.9	1.3	1.6	1.5	0.6	0.5	0.5	0.4	0.6	0.4	0.5	0.4
C.V.	12.69	63	7.7	7.1	8.1	5.6	6.9	6.3	6.2	5.0	4.5	4.2	5.5	3.7	4.3	3.6

Table 2 Impact of agronomic management techniques on Kinnow (Santra) yield parameters: Conserved moisture with low input (CMLI) and Adequate irrigation with high input (AMHI)

Management of agriculture	Days to first harvest		(DAS)		Crop duration (DPS)				Number of fruits per vine				Fruit weight (g)			
Procedures	2017	2018	2019	Mean	2017	2018	2019	Mean	2017	2018	2019	Mean	2017	2018	2019	Mean
CMLI	84.6	83.2	79.99	83.2	115	113	112	112	13.0	13.2	13.2	11.8	349.2	348.8	345.0	346.8
AMHI	90.5	91.6	98.21	98.1	143	123	103	123	19.4	15.7	15.7	15.7	396.6	430.7	337.8	3911
C.D.	2.3	2.3	2.3	2.5	2.5	5.8	1.4	3.2	1.0	0.9	2.0	1.8	32.2	19.2	32.6	18.6
SE(m)	1.0	1.0	07	0.8	0.8	1.5	0.4	0.7	0.3	0.3	0.3	0.3	7.2	5.6	7.3	5.4
C.V.	3.5	3.6	2.6	2.9	2.0	3.8	1.1	1.7	7.3	6.1	7.1	5.9	6.1	4.7	6.4	4.6

When contrasted with CMLI, AMHI considerably enhanced Kinnow (Santra) development. Harvest duration (132 DAS), fruit yield (5.77 kg), fruit mass (391.1 g), and fruit density per stem (14.7) were the evaluation parameters. Fruit production increased as a result of plants' ability to extend their root systems and absorb more nutrients brought about by the soil's abundance of moisture. The results demonstrated that watering with high inputs resulted in a 25.16 percent higher Kinnow (Santra) fruit yield per hectare (96.2 t/ha) compared to soil moisture conservation with low inputs (71.99 t/ha). Kinnow (Santra) fruit set increased in frequency and weight as soil moisture and fertilizer levels were just right. Previous crop studies corroborate all of the aforementioned findings.

Kinnow (Santra) crop profitability was affected by irrigation management and agronomic inputs (Table 3). Compared to Kinnow (Santra) grown with low inputs and soil moisture preservation, three years of suitable irrigation and high production inputs cost 5,28,070 per hectare gross and 3,48,220 per hectare net.

There was very little variation among years and methods with respect to the daily production of 731 kg/ha and the net returns of 2,646 rupees/ha. Insufficient irrigation resulted in a benefit-cost ratio of 2.94, whereas conserving soil moisture with modest inputs had a ratio of 3.64. When compared to farmers who rely on irrigation and other inputs, early-season farmers often get a better price for their products. The flavor and quality of Kinnow (Santra) were enhanced by hot, dry, humid, and low night temperatures, which were caused by soil moisture conservation measures. The data above shows that producing Kinnow (Santra) s under stressful conditions in this area is highly profitable. Kinnow (Santra) growers appreciate it because it delays harvesting by preserving moisture. Because of this, these varieties of Kinnow (Santra) are more expensive. According to Holzapfel and Mariño (2008), in order to achieve optimal output, irrigation systems strive to completely substitute cultural evapotranspiration. Reducing water usage does not necessarily mean sacrificing yield, according to the tests. Environmental stress is known to enhance health, quality, and postharvest preservation, according to good evidence. It is possible to enhance the beneficial components of food samples by subjecting them to controlled stress, such as heat, water stress, or salt. Managed abiotic stresses enhanced plant resistance to biotic pressures, such as pests and diseases, according to experiments conducted on all fruit and vegetable crops. Think about this fascinating aspect.

Table 3 Impact of agronomic management techniques on Kinnow (Santra) profitability metrics: conserved moisture with low input (CMLI) and adequate irrigation with high input (AMHI)

Practices of Agronomy Management	8:C ratio				Daily productivity (kg/ha)				Net returns per day		(Rs/h a)	
	2018	2019	2018	Mean	2018	2019	2018	Mean	2018	2018	2018	Me an
CMLI	3. 93	3. 36	3.78	3. 46	612	624	645	613	2359	3432	4505	289 0
AMHI	2.78	3. 20	3. 20	2. 49	743	715	780	713	2434	2835	2481	24 6
C.D.	0.27	0.30	0.34	0.27	54	71	NS	59	NS	424	487	NS
SE(m)	0.08	0.09	0.11	0.08	17	22	22	18	92	131	150	107
	8.4	8.8	9.7	7.9	7.9	10.0	10.4	8.4	11.9	14.4	13.8	12. 0

Conclusion

Through the implementation of this in-situ moisture conservation method or the implementation of area-specific agro ecological adaptations, the fertility of the soil is maintained, and moisture is kept. This modification gives insight on how formal and informal information might be leveraged to produce greater adaptations, so transforming difficulties into opportunities. This comprehension is beneficial for the advancement of formal science. The farmers whose land is dispersed around the Hemawas dam are the ones who are responsible for the retention of runoff water in the 260-hectare catchment area that is utilized for this purpose. As an alternative to cultivating low-yielding crops such as wheat, barley, mustard, and chickpea, the farmer in the Hemawas dam catchments area made great use of the stored soil moisture by cultivating Kinnow (Santra).

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