Iron ore mining and food security of rural household – an analysis in Odisha, India

The present paper attempts to assess and analyse the situation of food security in the context of its accessibility and utilisation among rural households in iron-ore mining region of Odisha, India. A comparative approach with statistical techniques like t-test, Z-test and F-test has been used in the present study. It has been found out that despite of higher average income and expenditure on food, the average calorie intake of households in mining region is significantly lower than the households in non-mining region. Even the proportion of households suffering from calorie deficiency is significantly higher in mining areas than in non-mining areas. The reason behind is the heavy dependence of household on market for consumption of rice. This shows that mining activities do not ensure food security to its rural households and have a significant negative impact on it. Hence, suitable policy measures should be undertaken by the administrative machinery so that mining could not only contribute the economic development of the region but would also ensure food security to the households in the region.

Keywords: *Calorie, mining, access, deficiency, food security, utilisation.*

1. Introduction

Mineral resources are considered to be blessings for the region where they exist. Numerous studies have shown mining to contribute in the development of the local communities through employment creation and economic well-being (Bogdetsky et al., 2005; Ejdemo and Soderholm, 2011; Sahoo et al., 2017). It has also generated non-mining related employment through estimated multiplier effects which have often been more than direct employment created by new mines (McMahon and Remy, 2001; Opoku-Ware, 2010). Odisha being one of the rich mineral bearing states of India too considers mining to be the core sector for the development of its economy (Government of Odisha, 2017). The state is a treasure house with large varieties of metallic and non-metallic minerals which include chromite, bauxite, garnet, iron ore, manganese ore, quartz and quartzite, fireclay, nickel, copper, lead, coal and many precious stones. It has earned the distinction of one of the leading producers of mineral resources (Indian Bureau of Mines, 2018).

Dr. Minati Sahoo, Asst. Professor, Dept of Economics, Central University of Orissa, Koraput, Odisha 764021, India.

Additionally, mining cannot be done without disturbing the existing environment (Chauhan, 2010; Panwar et al., 2011; Adetayo, 2012). It is considered to be a major polluter of ecosystem, water and air and driver of climatic change that is destroying the conditions necessary for the healthy agriculture and food sovereignty. It promotes myths of job creation, economic growth and well-being while undermining sustainable, resilient and localized food production. Despite of large possession of land, people in mining region have given up farming and have shifted towards mining related jobs (Mishra, 2009; Sahoo et al., 2018). Further degradation in the quality of soil due to mining activities has rendered the lands unproductive and not usable (Tenkorang and Kufuor, 2014), thereby negatively affecting food production and food security (Mishra and Pujari, 2008; Ocansey, 2013; Juma, 2015; Sahoo, 2016). Thus the extraction of minerals has led to negative spill over effects on agriculture activities and poses a threat to food security in the region.

Food security is defined as a situation "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life''. This accepted definition points out four dimensions of food security: availability, access, stability and utilisation (FAO, 2006). Food security includes not only the problems of physical availability of food stocks but also the access to food stocks and biological utilization of food consumed. While most of the studies as shown above have focussed the issue of food insecurity in mining region on the basis of availability but examining in the context of food utilisation have never been taken up. Besides, the quality of human capital is seriously affected by food and nutrition deficiencies and, unless tackled early, may pose a serious obstacle to sustainable development (Behera and Penthoi, 2017). Thus this raises a pertinent question that whether rural households in the mining region are also food insecured in the context of food access and utilisation? What is the impact of mining on the food security of these rural households measured on the basis of access and utilisation dimension? Thus, an attempt has been made in the present study to assess and analyse the conditions of food security in terms of accessibility and utilisation among mining households in the Keonjhar district, the mining hub of Odisha.

2. Research design

Keonjhar, one of the premier mineral producing districts in Odisha has been used as study area for present research. Its main mineral production activity is iron ore. It has also minerals like manganese, chromite, limestone, dolomite, quartz, asbestos, pyroxenite, china clay, pynophyllite and quartzite (Indian Bureau of Mines, 2018).

A comparative approach with and without mining has been used in the present study to analyze the condition of household food security in the mining region. Keonjhar district has seven mining blocks and six non-mining blocks. Four villages from mining block (mining villages) and four villages from non-mining block (non-mining villages) have been selected to analyse the household food security in the mining region. A stratified simple random sampling technique has been used to select 360 sample households of which 180 were from mining villages and 180 from non-mining villages. Data have been collected and analysed from primary and secondary sources. Primary data were collected by administering a structured surveyed schedule on the households of mining and non-mining area during May to December 2014. Further, observation and conversation were also used in the study. Mathematical and statistical techniques such as averages, percentages, F-test, Z-test and t-test have been used in the present study.

3. Results and discussions

Food security is defined, in its most basic form, as accessed by all people at all times to the food required for a healthy life. Food and nutritious diet are very important element for a healthy body. The term food refers to anything which nourishes the body and it should contain proper nutrition, vitamins which can help to sustain the body and keep the body healthy (Nisha, 2006). In order to analyse the food security in mining area, this section will make a comparative discussion on the calorie intake of mining household with non-mining household and the contribution of factors for the difference, if any.

3.1 Calorie intake of households in mining and non-mining villages

Nutritional status is one of the main indicators of food security of households and individuals. Nutritional status can be measured in terms of calorie intake. A household can be said to have food security "if calorie intake is more or at least equal to standard required calorie". A household will suffer from food insecurity when there is nutritional or calorie deficiencies. This would be the case when household calorie intake is less than standard required calorie. It is an established fact that the standard requirements of calorie are different for different age group. Besides age, physical activity is also an important factor to determine the requirement of calorie. Table 1 gives information on this. Further, physical activity depends upon the types and nature of occupation. The nature of work on the basis of types of occupation is depicted in Table 2.

It can be seen that with a change in nature of work from sedentary (light work) to moderate to heavy work, the

Table 1: Distribution of standard calorie requirement according to different age group and type of work

Group	Age	Nature of work	Standard calorie requirement per day (in calorie)
Infant	0-6 months	-	108
Infant	Above 6 and 12 months	-	98
Children	Above 1 and below 3 years	-	1240
Children	Above 3 and below 6 years	-	1690
Children	Above 6 and below 9 years	-	1940
Boys	Above 9 and below 12 years	-	2190
	Above 12 and below 15 years	-	2060
	Above 15 and below 18	-	2640
Girls	Above 9 and below 12 years	-	1970
	Above 12 and below 15 years	-	2450
	Above 15 and below 18	-	2060
Men	Above 18	Sedentary	2425
		Moderate	2875
		Heavy	3800
Women	Above 18	Sedentary	1875
		Moderate	2225
		Heavy	2925

Source: Nisha, 2006

standard requirement of calorie intake increases. This is because of the increase in physical activity from light work to medium to heavy work. Generally, the mine workers are highly active workers. In this category standard calorie for men is 3800 calorie per day and for women is 2925 calorie per day.

The requirement of calorie will be multiplied with number of persons of each group (age, sex and types of works) and get the total requirement of calorie per household. Calorie is the most crucial element for a healthy body upon which present study will analyse the food security of inhabitants of mining region. Calorie intake of a person can be calculated from consumption of food items that he/she consumed. The total calorie intake of a family will be calculated from the different food consumption of that family. Generally the people in this region consumed rice, potato, vegetables, dal, meat, chicken, egg, wheat, fruits and milk.

Access to adequate food and proper nutrition is one of humanity's basic needs. A comparison of distribution of households in mining and non-mining areas according to their calorie intake shows that majority of households (34%) in mining villages is having a calorie intake of 1500-2000. But in non-mining villages, majority of households (69%) come under the calorie range of more than 2500 cal per day which is higher than mining village (31%). Thus the percentage of household having higher calorie intake is more in non-mining households than mining households (Fig.1).

Further, by doing Z-test (Table 3), it can be seen that proportion of households in non-mining villages are significantly more than mining villages for calorie range of

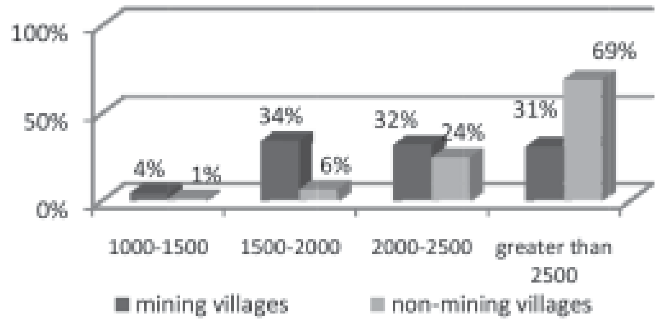

Fig.1 Percentage distribution of households according to calorie range in mining and non-mining areas

Source: Compiled by author from primary data

more than 2500 at 1% level of significance. On the other hand, mining households are found to be significantly more than non-mining households for calorie range of 1000-1500 and 1500-2000 at 5% and 1% level of significance.

Good financial resources permit the household to have more expenditure on food which will lead to a healthier life and a well-balanced diet. Many researchers found that there is a close relationship between income and nutritional status of family. And also it is seen that expenditure on food could better give the information on the nutritional status of the household. Thus the relationship between income of household and food expenditure and calorie intake in mining and non-mining villages is shown in Table 4. It depicts a positive relationship between per capita calorie intake and expenditure on food. This is to say that with the increase in expenditure on food, there is increase in per capita calorie intake of the family. Besides, a close and positive relationship

Table 2: Classification of occupation on basis of nature of work

Light work (sedentary worker)	Moderately active (active worker)	Very active (heavy worker)
Office workers	Housewife, casual industrial labour, forest-dependents, business, construction worker	Mining worker, agricultural worker, driver of heavy vehicles

Source: Nisha, 2006

Note: students, old age, unemployed have been taken into the category of light work

Table 3: Z#- test for number of households for different calorie range between mining and non-mining villages

Village	1000-1500	1500-2000	2000-2500	Greater than 2500	Total
Mining	7	61	57	55	180
	88%	85%	56%	31%	
Non-mining	1	11	44	124	180
	13%	15%	44%	69%	
Total	8	72	101	179	360
Z-value	2.1**	5.9*	1.3	–5.2*	

Source: Compiled by Author from primary data

Note: *Implies value significant at 1% level and **Implies value significant at 5% level

It's a test to Compare two counts (Poisson distribution), $Z = (R_1 - R_2)/\left(\frac{R_1}{t_1} + \frac{R_2}{t_2}\right)^{1/2}$, $R_1 = \frac{n_1}{t_1}$, $R_2 = \frac{n_2}{t_2}$, n_1 and n_2 are two counts taken over times t_1 and t_2 respectively (Kanji, 2001)

TABLE 4: AVERAGE INCOME, EXPENDITURE AND CALORIE INTAKE PER DAY OF HOUSEHOLDS IN MINING AND NON-MINING VILLAGES

Calorie Range	Average calorie intake of HH (per day)	Annual income	Annual expenditure on food
Mining village			
1000-1500	1410	113849	30984
1500-2000	1765	179933	37630
2000-2500	2233	195452	40982
>2500	2840	226906	45319
Total	2228	199270	41243
Non-mining village			
1000-1500	-	-	-
1500-2000	1841	81801	15288
2000-2500	2295	108134	20359
>2500	3062	136077	23589
Total	2773	126310	22379

Source: Compiled by author from primary data

between income and calorie intake is also seen. As the income increases, the calorie intake of the households also increases. This pattern is seen in both sample mining and non-mining villages. But some difference has been noticed when a comparison is made between mining and non-mining villages. It could be seen that in non-mining villages, at each calorie range the average calorie intake is higher than mining areas. This is despite the lower average income and expenditure on food than mining villages. Further we could find all the households in non-mining to having calorie range above 1500. Thus non-mining households with lower income and expenditure on food enjoys higher per capita calorie intake.

The calorie intake of mining areas (2228 per day) is less than non-mining areas (2772.8 per day). But whether this difference is statistically significant or not, a *t*-test is done. Table 5 shows the result of t-test for food intake in mining and non-mining areas. The p-value of two tailed test hypothesis is 0 which is less than 0.01 at 1% level of significance. Even the calculated absolute t-value (9.5) is more than critical value (2.58). This leads to the conclusion that is food security in terms food calorie intake in mining areas is different from non-mining areas. And, the calorie intake of mining areas is on average 546 cal per day less than non-mining areas.

Additionally, by examining calorie requirement and calorie intake of the households in mining village, it is found that 59% of households are suffering from calorie deficiency (Table 6). But the proportion of households suffering from deficiency in non-mining villages is 39%. It can also be seen from the table that with an increase in calorie range, the percentage of household suffering from deficiency and amount of deficiency declines. In mining villages, 86% of households suffer deficiency of more than 500. But with increase in calorie range for instance 1500-2000, there is only 25% of households suffering from more than 500 deficiencies. For more than 2500 calorie range, no household suffers from deficiency. Similar is the case in non-mining households. Analysing by the level of calorie deficiency, it could be seen that there are more percentage of households having a deficiency of 100-300 calorie per day in mining (24%) and non-mining villages (13%).

Further, it can be seen from Table 7 that the numbers of households having no deficiency and having deficiency of 100-300 are significant at 1% and 5% level respectively within mining villages. But, percentage of households having no deficiency is only found to be significant within non-mining villages. In addition to this, mining households having calorie deficient of 100-300 and 300-500 are found to be significant than non-mining counterparts at 5% and 10% level respectively (Table 8). On the other hand, non-mining households are significantly higher than mining households in the no calorie deficiency category at 1% level. Thus it can be seen that food insecurity is more in mining than non-mining areas.

Now if we look into the average values of calorie requirement, calorie intake and calorie deficiency/surplus, we could see that non-mining villages are in a much better situation than mining villages with respect to food security (Table 9). Among mining villages, Kundaposi and Kalimati villages are having a calorie deficiency of 99.4 and 125 respectively. The negative value shows the deficiency in calorie intake whereas positive value shows the surplus in calorie intake. The only non-mining village which suffers from calorie deficiency is Banachakulia. The other non-mining villages have calorie intake more than their requirement. The deficiency of calorie is not a good sign as it affects the health and result in number of diseases. Thus the calorie intake is less and calorie deficiency is more in mining villages than non-mining villages. In fact, we could find calorie surplus in non-mining villages. It was seen that calorie intake in mining

TABLE 5: INDEPENDENT TEST FOR AVERAGE CALORIE INTAKE OF MINING AND NON-MINING VILLAGES

		t-test for equality of means				
		t-value	df	*P*-value (2-tailed)	Mean difference	Std error difference
Average calorie intake	Equal variances assumed	-9.5	358	0.0*	-546	57.35
	Equal variances not assumed	-9.5	349	0.0*	-546	57.35

Source: Compiled by Author from primary data. Note: *Implies value significant at 1% level

TABLE 6: DISTRIBUTION OF CALORIE DEFICIENT HOUSEHOLDS ACCORDING TO CALORIE RANGE

Calorie range	No. of HH with calorie deficiency					
	No deficiency	Less than 100	100-300	300-500	Greater than 500	Total HH
			Mining village			
1000-1500	0	0	0	1	6	7
	0%	0%	0%	14%	86%	100%
1500-2000	3	4	24	15	15	61
	5%	7%	39%	25%	25%	100%
2000-2500	21	10	16	8	2	57
	37%	18%	28%	14%	4%	100%
>2500	49	3	3	0	0	55
	89%	6%	6%	0%	0%	100%
Total	73	17	43	24	23	180
	41%	9%	24%	13%	13%	100%
			Non-mining village			
1000-1500	0	0	0	0	1	1
	0%	0%	0%	0%	100%	100%
1500-2000	0	0	3	3	5	11
	0%	0%	27%	27%	46%	100%
2000-2500	8	12	11	5	8	44
	18%	27%	25%	11%	18%	100%
>2500	101	7	9	5	2	124
	82%	6%	7%	4%	2%	100%
Total	109	19	23	13	16	180
	61%	11%	13%	7%	9%	100%

Source: Compiled by Author from primary data

TABLE 7: F-TEST## FOR CALORIE DEFICIENT HOUSEHOLDS ACCORDING TO CALORIE RANGE WITHIN MINING AND NON-MINING VILLAGES

Calorie deficiency	Observed frequency for mining	Observed frequency for non-mining	Expected frequency	F-Calculated for mining	F-Calculated for non-mining
No deficiency	73	109	36	3.8*	2.0**
Less than 100	17	19	36	0.9	0.5
100-300	43	23	36	2.3**	1.2
300-500	24	13	36	1.3	0.6
Greater than 500	23	16	36	1.2	0.6
Total	180	180	180		

Source: Compiled by Author from primary data. Note: *Implies value significant at 1% level
##It's a test to Compare two counts (Poisson distribution), where F = $N_1/(N_2+1)$, N_1 and N_2 are two counts (Kanji 2006, p.60)

TABLE 8: Z-TEST FOR CALORIE DEFICIENT HOUSEHOLDS ACCORDING TO CALORIE RANGE BETWEEN MINING AND NON-MINING VILLAGES

Calorie deficiency	No deficiency	Less than 100	100-300	300-500	Greater than 500	Total
Mining	73	17	43	24	23	180
	40%	47%	65%	65%	59%	
Non-mining	109	19	23	13	16	180
	60%	53%	35%	35%	41%	
Total	182	36	66	37	39	360
Z-value	-2.66*	0.33	2.46**	1.8***	1.12	

Source: Compiled by Author from primary data
Note: *Implies value significant at 1% level, **Implies value significant at 5% level and ***Implies value significant at 10% level

Table 9: Average calorie requirement, intake and average calorie deficiency/surplus of households in mining and non-mining villages

Sample villages	Average HH calorie requirement	Average calorie intake of HH (per day)	Calorie deficiency /surplus* per HH
Mining villages			
Balda	2177.3	2227.9	50.6
Kundaposi	2282.9	2183.5	-99.4
Bada Kalimati	2356.2	2231.3	-125.0
Uchaballi	2274.4	2276.7	2.3
Total	2268	2227	-41
Non-mining villages			
Dhangardiha	2553.0	2823.9	270.9
Banachakulia	2580.3	2447.2	-133.1
Suneriposi	2624.1	2865.3	241.2
Sanajiuli	2593.6	2954.7	361.1
Total	2588	2773	185

Source: Compiled by Author from primary data
Note: negative value implies calorie deficient and positive value implies calorie surplus

is significantly less than non-mining. Even we could find that the calorie deficiency in mining is significantly higher than non-mining villages at 1% level of significance for both equal variances assumed and equal variances not assumed (Table 10).

Now an important question arises in mind that despite of higher income earning and expenditure on food in mining areas than non-mining areas, why calorie intake in mining areas is less than non-mining areas? An attempt has been made in the following discussion to find out the factors contributing to the low calorie intake in mining villages.

3.2 Reasons for household's food insecurity

There are three sources on which a household depends upon rice i.e. self-production, market and government. Many households grow paddy for own consumption. Apart from this, government through public distribution system used to provide rice to poor people at subsidised price. Rice is an essential and staple food for the poor people who depends on PDS to provide the same. Government of Odisha has introduced one kg rice at one rupee scheme on 1st February, 2013. The main purpose of introducing the scheme is to help the poor to alleviate hunger deprivation and poverty. The state rice supply scheme involves distributing to different group of people based on their socio-economic status. BPL families under this scheme are entitled to get 25 kg rice at Rs.1. Those families covered under *Antyodaya Anna Yojana* (AAY) are entitled to get 35 kg at Rs.1. At last, there is market from where people could purchase their desired amount. Now, it is required to make an assessment of the extent of dependence of households on these agencies and how these agencies help in ensuring food security (rice) to the households in mining and non-mining areas. The Table 11 shows the dependence of households for consumption of rice on three sources i.e. own/self-production, government and market. It can be seen that mining households depend more on market rather than on farming and government. This is because of no farming or very less farming in the villages and the availability of rice from government through PDS is not sufficient enough to meet the both end needs. So ultimately to fulfil their total consumption they have to rely on market for rice. In non-mining villages the scenario is totally different. Here, we could find very less dependence of households on external agencies like government/market. Cultivation is the principal occupation of the households in non-mining villages. Paddy is mostly grown by the farmers. It is used for domestic production and whatever surplus is left is sold in

Table 10: Independent test for average calorie deficiency/surplus of households in mining and non-mining villages

Variables		t-test for equality of means				
		t-value	df	P-value (2-tailed)	Mean difference	Std error difference
Average Calorie Deficiency/Surplus	Equal variances assumed	-4.4	358	0.0^{*}	-226	51.37
	Equal variances not assumed	-4.4	326	0.0^{*}	-226	51.37

Source: Compiled by Author from primary data
Note: *Implies value significant at 1% level

Table 11: Extent of dependence of households for rice consumption on different agencies in mining and non-mining villages

Village	Own production		PDS		Market		Total rice consumption	
	Average quantity (Kg)	% contribution to total consumption	Average quantity (Kg)	% Contribution to total consumption	Average quantity (Kg)	% Contribution to total consumption	Average quantity (Kg)	% of total
Mining	19	2%	145	15%	774	82%	939	100%
Non-mining	797	70%	223	20%	132	12%	1137	100%

Source: Compiled by author from primary data the market. Farming contributes 70% of the total consumption of rice in non-mining villages. Households also depend on PDS for consumption. Government through PDS contributes 20% of the consumption of non-mining households. Due to this, their dependence on market is very less i.e. 12%. Thus households in mining areas are seen to be more dependent on market than non-mining households. Dependence on market also makes households more vulnerable to risk like high price, unavailability etc. Since the households in mining areas purchase rice from market, they have to pay high price for it. For instance, household pays Rs.25 for 1 kg of rice from market in mining areas. But in non-mining areas, 1 kg of rice costs Rs.12-13. This is the price which households would be getting if they sell rice of same quantity in market. If a household is consuming 1 kg rice which is produced on their land then it is sacrificing Rs.12/13 which it could earn if not consumed. Thus this is the expenditure by non-mining household on 1 kg of rice. Since the cost of rice is less in non-mining than mining areas, expenditure made by mining households is more than non-mining households. This might be the reason for which food intake is more in non-mining than mining households.

It could be seen that the consumption of rice from own production and government is higher in non-mining than mining villages. But, consumption from market is higher in mining than in non-mining villages. And on the whole the total consumption of rice is found to be higher in non-mining than in mining villages. These differences are also significant at 1% level of significance with two-tailed test for both equal variances assumed and not assumed (Table 12). Thus, mining households are said to be more food insecure for their dependence on the market for consumption of the most important and high calorie food i.e. rice.

Thus from above discussion, it is seen that mining households spend more on food than non-mining households. But, despite of this the average calorie intake of mining households is less than non-mining households. This might be due to the following reasons: (1) heavy dependence of mining household on market for the consumption of rice and to bear higher expenditure and (2) the consumption of rice is less in mining households than non-mining households. Thus the percentage of calorie deficient households is more in mining villages than non-mining villages. All these reasons contribute to the food insecurity among the mining households even though mining has improved the financial/economic status of households.

4. Conclusion and policy implications

The present study concludes that mining has not ensured food security to its local inhabitants on the basis of utilisation dimension as the calorie intake from food in mining areas is significantly less than in non-mining areas. The percentage of household having higher calorie intake is found to be less in mining regions than in non-mining regions. It is also found that the average calorie intake of household in mining areas at each calorie range is lower than in non-mining areas. This is despite of their higher average income and expenditure on food. Even the proportion of households suffering from calorie deficiency is significantly higher in mining villages than in non-mining villages. The reason behind is significantly less rice consumption and higher expenditure on it by mining households than their non-mining counterparts. Higher expenditure by the mining household on rice is due to the heavy dependence on market for the consumption of rice where the price of rice is high. On the other hand, non-mining households mostly consume rice which they have produced. Thus, this shows that mining activities do have significant negative impact on the food security of local inhabitants in mining areas.

The issue here is not whether there should be mining or not. Rather it is about the policies, procedures, institutions that must be established to ensure that mining is done in a manner that is environmentally acceptable. Both the government and mining companies have to bear the responsibility to deal with the issue of food security by adopting some measures. Mining companies should

TABLE 12: INDEPENDENT TEST FOR THE EXTENT OF DEPENDENCE OF HOUSEHOLDS FOR RICE CONSUMPTION ON DIFFERENT AGENCIES IN MINING AND NON-MINING VILLAGES

Variables		t-test for equality of means				
		t-value	Df	Significance (2-tailed)	Mean difference	Std error difference
Rice from own production	Equal variances assumed	-19.87	358	0.0*	-777	39.12
	Equal variances not assumed	-19.87	204	0.0*	-777	39.12
Rice from PDS	Equal variances assumed	-4.40	358	0.0*	-77	17.57
	Equal variances not assumed	-4.40	355	0.0*	-77	17.57
Rice from market	Equal variances assumed	14.96	358	0.0*	642	42.92
	Equal variances not assumed	14.96	334	0.0*	642	42.92
Total rice consumption	Equal variances assumed	-3.96	358	0.0*	-198	50.04
	Equal variances not assumed	-3.96	348	0.0*	-198	50.04

Source: Compiled by author from primary data. Note: *Implies value significant at 1% level encourage the households to adopt farming by providing various inputs. To encourage the people in mining region for cultivation, government should step in and support the household in various ways for adopting farming. Government can demonstrate appropriate agricultural practices to farmers, hold farmer mela (fair) and provides information about sustainable agriculture and organic farming, provide technical support, training to farmer community, and arrange for soil testing and technical inputs for increasing yield, distribution of horticultural sapling etc. At last mining should be carried out in such a way that would contribute not only the social and economic development of the region but also would ensure food security to the rural households.

Acknowledgements

I would like to thank Dr. Dharmabrata Mohapatra (Ravenshaw University, Cuttack) and Dr. Dukhabandhu Sahoo (IIT, Bhubaneswar) for their guidance and suggestions constantly throughout this research work. The fieldwork data in this paper is a part of the author's doctoral research.

References

1. Adetayo, K.A. (2012): Effects of Sand Mining Activities on Land in Agraian Communities of Ogun State,Nigeria. *Continental Journal Agricultural Science,* 6 (1), 41-49
2. Behera, S and Penthoi, G. C. (2017): Food Insecurity and Government Intervention for Sustainable Food Access in Odisha. *International Journal of Latest Technology in Engineering, Management & Applied Science*, 6(2), 38-46. Retrieve from http://www.ijltemas.in/DigitalLibrary/Vol.6Issue2/38-46.pdf.
3. Bogdetsky, V., Karybek, I., and Jyldyz, A. (2005): Mining Industry as a Source of Economic Growth in Kyrgyzstan. Project implementation Unit of the World Bank, (IDF GrantNo. TF053432). Retrieve from http://siteresources.worldbank.org/INTOGMC/Resources/3360991156955107170/mining source economic growth.pdf.
4. Chauhan, S.S. (2010): Mining, Development and Environment: A Case Study of Bijolia Mining Area in Rajasthan, India. *Journal of Human Ecology*, 31(1), 65-72.
5. Das, N. (2002): *Sachitra Yoga Byaam*. Kolkata: Ironman Publishing House.
6. Government of Odisha (2017): Economic Survey of Odisha (2016-17). Planning and Coordination Department, Directorate of Economic and Statistic, Bhubaneswar, Odisha. Retrieve from http://www1.odisha.gov.in/pc/Download/Economic_Survey_2016-17.pdf.
7. Ejdemo, T. and Soderholm, P. (2011): Mining investment and regional development: A scenario-based assessment for Northern Sweden. *Resources Policy*, 36, 14-21.
8. FAO (2006): Food Security. Policy Brief. Retrieve from http://www.fao.org/forestry/13128-0e6f36f27e0091055bec28ebe830f46b3.pdf.
9. Indian Bureau of Mines (2018): Indian Mineral Yearbook 2016. Ministry of Mines, Government of India. Retrieve from http://ibm.nic.in/writereaddata/files/02202018152721Odisha%20AdvanceRe2016.pdf.
10. Juma, F. K. (2015): Effects of Mining on Food Security to Farming Communities Surrounding Nyamongo Gold Mine in Tarime District, Tanzania. Dissertation submitted to University of Agriculture. Morogoro, Tanzania. Retrieve from http://www.suaire.suanet.ac.tz:8080/xmlui/bitstream/handle/123456789/1266/FREDRICK% 20KISIKA% 20JUMA.pdf? sequence=1&isAllowed=y.
11. Kanji, G.K. (2006): "100 statistical tests". New Delhi: Sage Publications
12. McMahon, G. and Remy, F. (2001): Large Mines and the Community-Socioeconomic and Environmental Effects in Latin America, Canada and Spain. Ottawa:International Development Research Centre and Washington D.C: World Bank.
13. Mishra, P. P. (2009): Coal Mining and Rural Livelihoods: Case of the Ib Valley Coalfield, Orissa. *Economic & Political Weekly*, VXLIV (44), 117-123
14. Mishra, P.P and Pujari, A. K. (2008): Impact of Mining on Agricultural Productivity: A Case Study of the Indian State of Orissa. *South Asia Economic Journal,* 9(2), 337-350. Retrieve from https://doi.org/10.1177/139156140800900204
15. Mishra, S. (2011): Aahar Evam Posan ke Mul Tatvya. New Delhi :Sri Natray Prakasan.
16. Nisha, M. (2006): Health, Food and Nutrition. New Delhi: Kalpaz Publication
17. Ocansey, I. T. (2013): Mining Impacts on Agricultural Lands and Food Security-Case study of towns in and around Kyebi in the Eastern Region of Ghana. Thesis submitted to Turku University of Applied Sciences. Retrieve from https://www.theseus.fi/bitstream/handle/10024/53720/Ocansey_Ignitious.pdf? sequence=1
18. Opoku-ware, J. and Kutor, N. (2015): Mining our lives out: A food security approach to mining operation in Asutifi district of Ghana. *International Journal of Development Research*, 5(1), 3037-3045
19. Panwar, S., Sinha, R.K. and Singh, G. (2011): Time sequential surface change analysis of Talcher Angul Region of Orissa using Remote Sensing and GIS. *International Journal of Geomatics and Geosciences*, 1(4), 828-838

20. Sahoo, M. (2016): Challenges of Agriculture in Mining Region-A micro-level Analysis in Odisha .*The Indian Economic Journal*, Special Issue, 407-414

21. Sahoo, M., Mohapatra, D. and Sahoo, D. (2017): Mining and Livelihood: A microanalysis in Odisha, India. *International Journal of Social Economics,* 44(1), 93-113

22. Sahoo, M., Mohapatra, D. and Sahoo, D. (2018): Livelihood Dynamism in Mining region of Odisha, India. *International Journal of Environmental Science and Natural Resources,* 8(1): 555727. Retrieve from https://juniperpublishers.com/ijesnr/IJESNR.MS.ID.555727.php

23. Tenkorang, E. Y and Kufuor, , P. O. (2014): The Impact of Gold Mining on Local Farming Communities in Ghana.*Journal of Global Initiatives,* 8(1& 2), 25-44. Retrieve from https://digitalcommons.kennesaw.edu/cgi/viewcontent.cgi?article=1149&context=jgi