Feasibility Report on Installation of Rice Husk Power Plant in Bilaspur (C.G)

A Joint Study Conducted By:

IndianOil-CREDA Biofuels Limited
(A Joint Venture of IndianOil & CREDA)

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(A State University established by Chhattisgarh Vishwavidyalaya Amendment Act 2011, No. 07 of 2012)

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ABSTRACT:

The rising cost of fuel oil compelled the industry to search for alternative fuels, and biomass in general and rice husks in particular were considered a suitable alternative for producing energy. Chhattisgarh, being a rice producing state has a very good opportunity of rice husk to use as a fuel for power plants. This paper aims to show how rice husk can become one of the major energy sources for the agro-industrial sector. Rice husk accounts for an appreciably high pe rcentage by weight of rice it comes from rice milling process as a by-product. Major three uses of Rice Husk Ash are in the steel, cement and refractory bricks industry. Generally, a large amount of rice husk is dumped as waste which results in wa ste disposal problem and methane emission on decomposition. The u se of rice husk for el ectricity generation in effi cient manner in Chhattisgarh is likely to tran sform this agricultural by-product or waste into a valuab le fuel for industries and thus might help in boosting the fa rm economy and rural development of this newly developed state. In fact a systematic approach to this material can give birth to a n ew industrial sector of rice husk power production in India. The use of rice husks for process power generation has lots of benefits like the process is carbon-neutral and is renewable source of energy, thereby reducing the emission of greenhouse gases. For large capacity biomass plants arranging fuel is a big proble m. Though bio-mass plants were set up to meet the n eeds of the eco nomy, these p lants had to face continuous threat of shut down due to low availability of biomass. Many of them either have closed its operation or have fully depended on coal to g enerate power. Given the current state of the s ector, most of the f inancial institutions are shying away from financing, or are pr oviding loans at higher interest rates. Small-scale off-grid plants are better because biomass can be arr anged to some exten t with strategic long-term sourcing of biomass. U nlike the gri d-connected ones which feed power into the main grid, a decentralized process would work in efficient way where such p lants supply electricity directly to the village or small scale industries. Power generation from Rice husk can be one of the processes of decentralized efficient electricity supply.

Chapter 1 Introduction:

The majority of population in the rural areas of Chhattisgarh lives below the poverty line and has limited access to electricity. This has affected the development of the state to a large extent. The need of electrifying the villages in Chhattisgarh has been incubated by a new innovative system to generate power from rice husk. This rice husk, when used in efficient gasification or combustion systems, has a co nsiderable potential to generate energy. Rice is the main crop of Chhattisgarh, which falls in the rice belt of India well known as Rice Bowl. The term rice husk refers to the byproduct produced in the milling of paddy and forms 16-25% by weight of the paddy processed. In the majority of rice producing countries much of the husk produced from the processing of rice is either burnt for heat or dumped as a waste. India alone produces around 120 million tons of rice paddies per year, giving around 24 million tons of rice husks per year. Farm income can be increased both directly and indirectly if economically profitable means of utilizing rice husk are adopted in industry. There are many reported uses of rice husk such as a fuel in brick kilns, in furnaces, in rice mills for parboiling process, in the raw material for the production ofxylitol, furfural, ethanol, acetic acid, ligno sulphonic acids, as an cleaning or polishing agent in met al and machine industry, in the manufacturing of building materials, etc. Despite having so many well established uses of rice husk, only little portion of rice husk produced is utilized in a meaningful way and the remaining part is dumped as a solid waste or it is used as a cattle feeding.

Chapter 2: Overview of Chhattisgarh and Rice production

Chhattisgarh has a tremendous agricultural potential with a diversity of soil and climate, mountains, plateau, rivers, natural vegetation and forest. The rainfall ranges from 1200 mm to 1400 mm in different years. Diversified crops and cropping systems are the typical characteristics of Chhattisgarh. Rice is the major crop of the region. The cropping system of the state is mainly rain dependent. The main sources of irrigation are canals, fed by major, medium, and minor irrigation projects, which are also rain dependent.

2.1 Geographical indicator

The general climate of Chhattisgarh state is sub-humid with a distinct and long dry season. The region receives rainfall mainly through the south-west monsoon. Rainfall during July and August is usually high in the whole region, and remains stable till mid September.

Across Chhattisgarh, soil types are diverse because of the topographical variations. In the upper part of the landscape, the soils are usually shallow and young, with less developed features, and are frequently highly eroded. In lower topographic positions, soils have more developed features.

Chhattisgarh is popularly recognized as rice bowl of the country and about 69.7 per cent of net sown area is covered under *kharif* rice. But, the productivity of rice is very low. Rice is cultivated in all 27 districts of Chhattisgarh; however most of the districts are under medium-low productivity group, low productivity group and very low productivity group.

Table 1: List of Popular Varieties:

Varieties / Situations	
Uplands: Bhata lands of Chhattisgarh Plains:	Kalinga-3, Aditya, Vanprabha, Vandana
Unbunded uplands of Bastar and Surguja Zones	Kalinga-3, Aditya, Vanprabha, Vandana, Annada, Tulsi, Poornima, Danteshwari, Samleshwari
Bunded Lowland Rainfed	
Matasi:	Annada, Tulsi, Poornima, Danteshwari, Indira Barani Dhan – 1
Dorsa:	IR 36, IR 64, Kranti, Mahamaya, MTU 1010, Karma Mahsuri, Chandrahasini,

	Indira Maheshwari
Kanhar:	Indira sugandhit Dhan -1, Kranti, Mahamaya, MTU 1001 (Vijetha),
Behra:	Safri-17, Mahsuri, Swarna, Shyamla, Bamleshwari
Irrigated Lands:	
Inbred Varieties:	IR 36, IR 64, Abhaya, Kranti, Mahamaya, Madhuri, HMT- Sona, Bamleshwari, Pusa Basmati-1, Taraori Basmati, MTU 1001 (Vijetha), MTU 1010, Indira sugandhit Dhan -1, Karma Mahsuri
Hybrids:	KRH-2, PHB-71, PA 6444, Indira Sona

Source: Status Paper on Rice for Chhattisgarh, Directorate of Rice Research

In Chhattisgarh, rice milling is accomplished by both modern mills and traditional huller mills. Traditional huller mills are mostly located in rural areas and handling small quantities of paddy for day to day requirements of the rural households. *Konda* (mixture of husk, bran, germ and small broken rice) is a single valuable by-product obtained from huller mills which is used as cattle and poultry feed. In the huller mills, the quantity of broken are very high as compared to that of modern milling system and it is unavoidable. In modern milling system, husk (22-24%), bran (6-7%), germ (1%) and fine bookends (1-2%) are the by-products obtained separately. The broken percentage depends on the quality of the machine used for milling. Husk is sold at Rs. 1500 (approx.) per MT and is mostly used as fuel in power plants, brick industries and rice mills. This is also used as packing material for transport and as thermal barrier.

Bran, the valuable by-product from rice milling industries contains approximately 20-22% oil, the raw material for solvent extraction plants. Rice bran oil has good market in India as it is sold as edible oil after refinement as rice bran oil and also used for fortification with some other oils. The defatted bran is the raw material for poultry feed manufacturing industries. In addition, germ and small broken are the other by products of the rice milling operation.

Table 2. ANALYSIS OF THE CONTENTS OF RAW PRODUCT RICE HUSK

Property	Value
Moisture Content (wt %)	6.08
Ash Content (%)	23.39
Calorific value (MJ/kg-kcal/kg)	14.49-3470
Bulk density (kg/m^3)	90

Source: Journal of Science and Technology, Volume 47, Number 5A

Chapter 3: Rice procurement and custom milling and survey findings

A notification was issued to the Collectors of each district from The Dept. of Food and Civil Supplies regarding purchase of rice on minimum support price through Chhattisgarh State Co-operative Marketing Federation Limited (Markfed). The minimum support price is declared by the central Govt . each year for common and Grade A type of paddy . Procurement of paddy is done through the Samities, which are computer registered under Marked. The farmers of each village are to register themselves and furnish land related information to estimate the production of rice in advance in each season by the state government. Based on the collected information estimates of maximum availability of paddy is estimated for purchase from the farmers. The farmers are encouraged to register themselves in concerned registered societies under Markfed. The process is continuous in nature and the same information is being uploaded in the govt. website time to time. The information related to rice procurement is advertised through banners, handbill, and radio station and in television advertisement. The detail specification for A grade quality paddy and the support price is also displayed through banners in each paddy procurement centre. Moisture meters are also installed in the centre to check the moisture content (< 17 %) of the paddy. Before the procurement process starts the required materials such as gunny bags, weighing machine, polythin cover, drainage material, cement block, fly ash bricks etc and required labours are estimated and planned well before. Special care is taken in newly registered purchase societies so that the process becomes complete without any difficulty. Use of computer is being encouraged to upgrade the process, minimizing errors and to bring transparency in the system. Each village is registered under a nearest paddy purchase centre. Similarly farmers of each village are to sell their produce to the registered purchase centre. Quality, storage, transportation, inspection and arrangements are done jointly by Food Corporation of India (FCI) and Markfed. To check as additional measure a committee comprised of a) President of Sahakari Samiti /authorized representative, b) Sarpanch of the village, c) One representative of Collector, d) 2 member nominated by the minister is formed. After purchase of rice from the farmers a receipt is generated through computer based on which payment is made to the respective farmer through cheque.

To reduce the transport and storage cost, registered millers are contacted before hand and based on the requirement paddy is sent directly to the nearest millers for milling

purpose from the paddy collection centre. During study it was found around 95%-99% paddy was directly sent to the rice millers during the year 2011-12 and 2012 -13 from all the paddy procurement centers in Bilaspur district.

Table: 3 Paddy procurement and Milling quantities, Bilaspur district in 2011-12 & 2012-13

Sl. No	Year	Total paddy procured (in quintal)	Total paddy sent for milling (in quintal)	Remaining paddy (in quintal)	Milling percentage
1	2011-12	3526928.60	3504919.57	22009.03	99.28 %
2	2012-13	3799611.46	3760060.39	39551.07	98.96 %

Source: Dept. of Food, Civil Supplies & Consumer Protection, Chhattisgarh

To handle different issues related to paddy procurement and custom milling a call centre (toll free number 1800-233-3663) is operated and managed by the State Govt. Similarly to handle issues in district level monitoring rooms are also formed.

3.1 Methodology:

Literature survey: Secondary data collection was done through the university library using a range of information sources such as academic and commercial abstracts, bibliographic databases, and Internet search engines.

Data Collection and samplings: Primary data collection was done through stratified random sampling of the Rice mills of Bilaspur district and questionnaire surveys (Annexure: I). Although individual discussions, interactive discussion, focused group discussions were also held with various departments such as Rice Millers association, Markfed, FCI, different govt. office etc and existing biomass based power production units.

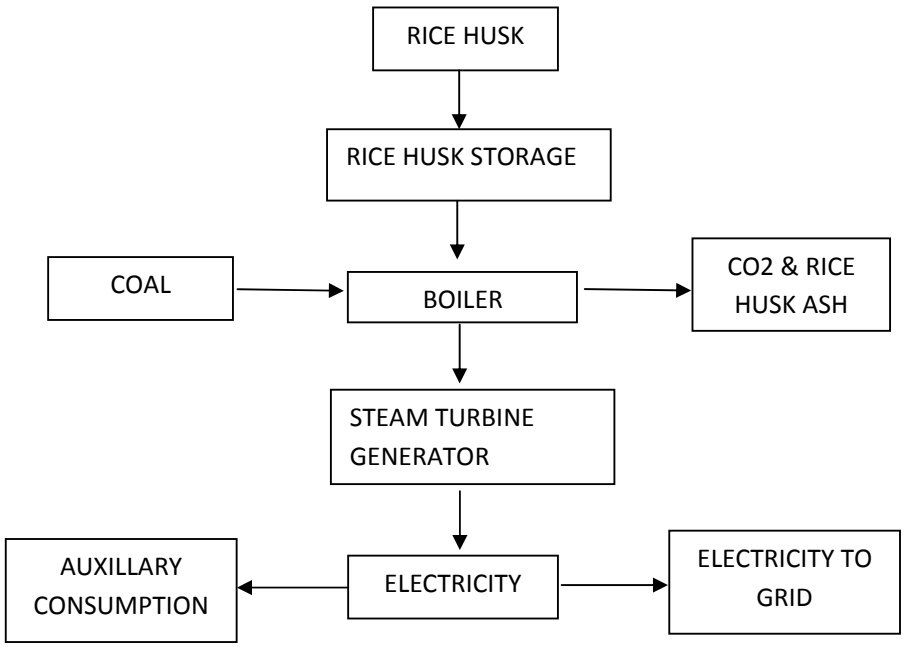
To restrict the study registered Rice mills of Bilaspur were taken into consideration. Among them number of Parboiled Rice Mill is 24 and Arwa rice mill is 81, with a total milling capacity of 99.6 tph² and 240.50 tph² respectively. Randomly selected rice mills of Bilaspur district (Annexure: II) were visited with predefined questionnaire to understand the prospect of commissioning biomass based power plant.

Table: 4. approximate calculation analysis for a 1 MW Power plant

1	Time of operation of the plant: 20 hrs
2	Days=270 days a year
3	Minimum amount of electricity generated for 1 MW power plant= 5400 MWh/year
4	Amount of heat required = 19440 G.J/year
5	Considering that approx. 25 % of heat generated "in the boilers will be converted into the electricity, the broilers need to provide 77760 G.J /year
6	Based on the calorific value of 14.49 MJ/kg for the rice husk to be used as and considering 85% combustion efficiency, the quantity of rice husk needed to produce the required amount of energy will be approx. 6320 tones/year (approx.)
7	To produce 1 MWh, approximately 1.2 tons of rice husks is required.

Source: Research paper on Sustainable Energy Demands, Technical journals online.com

3.2 Flow chart illustrating electricity generation from rice husk:



3.3 Fuel Requirement, Availability and Utilization:

Quantity of the rice husk used in the boiler as fuel

The rice husk received from the rice mills is stored in the plants storage area specially designed for such storage. From the storage area the rice husk will be transferred to the intermediate bunkers by bucket elevator/belt conveyor. An approximate measure of the shift-wise usage of rice husk is done at this point by scaling the bunker. Belt conveyors transfer the rice husk from the bunkers to the feeding hopper of the boiler, from where rice husk is fed into the boiler. Control of fuel feeding is done by controlling the rpm of the motors operating in the feeder system.

Quantity of the coal used in the boiler as fuel

Co-firing of coal with rice husk demands a similar monitoring system in place for the amount of coal fired.

Quality of Rice husk used in the boiler

The main type of fuel for the power generation is only rice husk. The properties of the rice husk from ultimate analysis, calorific value, ash composition etc. are already established and will be consistent in the region. However, it is proposed to monitor various properties of rice husk used as fuel, by taking samples at random, so that in case of any drastic change in the properties, corrective actions can be taken.

Quality of coal co-fired with rice husk in the boiler

Coal is co-fired with rice husk in the broiler. The properties of the coal from analysis - calorific value and composition etc. are already established and will be consistent in the region. A monitoring protocol similar to that of rice husk should be maintained for coal.

Operational Parameters of the power generating Unit

Total Power Generated

The total power generated by the power project would be measured in the plant premises to the best accuracy and will be recorded, monitored on a continuous basis.

Power consumed by the plant auxiliaries

The power consumed by plant auxiliaries would be recorded in the plant premises. All instruments will be calibrated at regular intervals. All instruments carry tag plates, which indicate the date of calibration and the date of next calibration. The total quantum of power consumed by the auxiliaries would affect the total power to be exported to the grid and therefore the amount of GHG reductions.

Power exported to the grid

The project developer will install all metering and check metering facilities within the plant premises. The measurement will be recorded and monitored on a continuous basis by the project developer. All instruments would be calibrated at regular intervals.

A case study: Vandana Vidhyut Limited, Bilaspur

Vandana Vidhyut Limited (VVL) incorporated on 10th November, 1995 to set up a 7.7 MW rice husk based power plant at Sirgitti, Industrial Area, Bilaspur, Chhattisgarh. The purpose of the project essentially was to utilize available rice mill generated rice husk as a sustainably grown and un-utilized waste biomass resource effectively for generation of steam and there from electricity. It commenced generation in October 2001 with initial capacity of 6 MW as per PPA with CSEB. The electricity thus generated would be sold to the state grid as per terms of the Power Purchase Agreement (PPA) with Chhattisgarh State Electricity Board (CSEB). Coal is co-fired with rice husk to maintain consistency in generation. Provisions of co-firing will also take care of any exigency arising from shortage of supply of rice husk.

The power is produced by operating a 7.7 MW fully condensing steam turbine with alternator. Major equipments of the power project under implementation comprises of 35 tons per hour (Tph) capacity fluidized bed combustion type boiler with the outlet steam parameters of 66 kg /cm2 And 500oC and the bleed-cum-condensing type 7.7 MW capacity turbo-generators. It has signed long term agreement with different rice millers to get continuous supply of rice husk. The power is generated at the plant at 11 kVA which is stepped up to 33 kVA for supply/wheeling through the CSEB substation, located at 1.5 Kms from the plant.

Chapter 4: Conclusions

The use of rice husks for process power generation has a number of benefits which has been discussed herein Power generation by using rice husk is a carbon-neutral and renewable source of energy, thereby reducing the emission of greenhouse gases; it also results in a reduction in emissions of sulfur and other pollutants associated with the use of fossil fuels, thereby improving local environmental conditions. This process also has a role in i mprovement in the e fficiency of the husk-fired boilers, leading to its acceptability by t he industry and other stakeholders as an acceptable practice and in development of the local economy by creating a market for rice husks Thus the former problem of disposal of rice husk as waste gets solved too and the power generated can meet the thermal energy requirements of the process industry in a mo re cost-effective manner even at grass root level, this process can generate employment for coll ection and supply of rice husks.

During discussions and meeting of the rice millers it was found that in most of the rice millers which are mi lling per boiled rice are using the rice husk for steam generation in broiler in the same mill through cogeneration process. It helps them to reduce the cost of coal and similarly utilizing husk, which is often a problem for disposing. In case of arwa millers, husk is a byprod uct and is mostly dumped in ne arly area at the mills. The husk is often bought by small brick kilns, tiles manufacturing, packaging, particle board manufacturing and power generation plants at nearby area. There are m any reasons associated with rice husk for not being utilized effectively, like, (1) lack awareness of its potential to a farmers and industry persons, (2) insufficient information about proper use, (3) socio-economic problems, (4) penetration of technology, (5) lack of interest, (6) lack of environmental concerns, (7) inef ficiency of information transfer, etc. Solution to the problems associated with utiliza tion of this solid waste needs to be worked out not only from the quality point of view but quantitatively as well, b ecause quantity of rice husk produced is very large. But the most promising and profitable use of this biomass is its utilization for the power generation in efficient way adopting efficient equipment. The use of rice husk-fired boilers for the generation of process steam generation has already been applied at a large number of locations throughout the country.

The decision regarding the choice of fuel for process steam is made based on the availability of rice husk, other techno-commercial consideration and cost benefits. Partial

and uneven combustion of husks in the furnaces of the boilers also would lead to smoke emissions. Combusted rice husk give the Rice Husk Ash (RHA). There are several projects to use rice husk in an electricity generation plant, where the obstacles are the low bulk density and calorific value of rice husk.

Rice husk is utilized where it is produced on small scales in brick kilns as a fuel. Despite having so many well established uses of Rice Husk, it is waste when large quantity is generated. So many small size thermal power plants are coming up, based on rice husk as a fuel. But, none of them have concrete plans for utilization of rice husk energy.

About 60 per cent of the country's grid-connected power plants that run on biomass are either closed or about to be closed. Reason: rising fuel price, unrevised tariff and government apathy. Chhattisgarh has the highest installed capacity of 249.90 MW. But out of the twenty nine plants only four are working.

The primary reason behind the downfall of the sector is the competition from other industries which have started replacing their fuel, like furnace oil and coal, with biomass. Brick kilns are the state's biggest biomass competitors. Kiln owners are purchasing biomass as it is cheaper than coal. Purchase cost of rice husk also varies time to time which makes difficult for power plant owners to keep sustain supply of biomass in their plants. Chhattisgarh being a power surplus state, it is difficult for plant developers to pay the high cost as their cost of generation would rise and electricity boards buy electricity at lower tariffs. For biomass plants with larger capacity arranging fuel is a big problem. To meet the economy of scale larger capacity plants were established which face continuous threat of shut down due to low availability of biomass. Many of them either have closed its operation or have fully depended on coal to generate power. Knowing that the biomass fuel market is unregulated, the government should have been cautious before allowing it for power generation. The government, moreover, quotes higher power potential of the available biomass without considering that many industries use biomass. Given the current state of the sector, most of the financial institutions are shying away from financing, or are providing loans at higher interest rates. Small-scale off-grid plants are better because biomass can be arranged to some extent with strategic long-term sourcing of biomass. Unlike the grid-connected ones which feed power into the main grid, a decentralized process would work in efficient way where such plants supply electricity directly to the village or small scale industries.

Annexure: I

Qualitative assessments:

1. Year of establishment/commission of the mill:

2. Name of nearby villages:

3. Mandi/Samities from which paddy is purchased:

4. Storage of Rice Husk:

Fully open storage with boundary wall	Partially covered storage	Completely covered storage

5. Use of Rice Husk: (open ended)

6. Buyers of rice husk: (open ended):

7. Price variations of rice husk per ton (in range): (open ended)

8. Transport cost of rice husk per ton/km: (open ended)

9. Modus operandi for selling of rice husk and fixing of rate: (open ended)

10. General views of the producing electricity/ power through rice husk: (open ended)

Quantitative assessment:

1. Rice mill category:

Small (less than 3 ton/hr)	Medium (3 to 15 ton/hr)	Large (More than 15 ton/hr)

2. Milling capacity in metric ton:

3. Paddy arrivals in Kharif (in tones) …… Rabi (in tons) ……

4. Milling operations : Per-boiled/ White(raw)/ Both

5. Cogeneration unit present : Yes /No

If yes: How much electricity / power is generated? (Open ended)

Is it sufficient to meet the requirement of the operations? (Open ended)

6. Name of few buyers of rice husk : (3-4 agencies)

7. No number of months when the mill is operational: (open ended)

8. Name of the nearest rice mills and approx. distance: (open ended)

9. Whether The rice mill is open for selling rice husk to any other agency : (yes/no)
   If no: reasons to be mentioned:

10. Any other information regarding rice mills and husk: (open ended)

Annexure: II

S. No	Name Of Rice Mills	Tahsil	Village	Arva Milling Capacity	Usna Milling Capacity
1	Laxmi Food Products	Bilaspur	Sirgitti Industrial Area	6	0
2	Annapurna Agro Industries	Bilha	Keshla/12	6	0
3	Shri yash Industries	Bilha	Bodri	6	0
4	Prachi Milling Industries	Kota	Ratanpur	6	0
5	K.B. Products	Bilaspur	Sirgitti	6	0
6	Sahivam Rice Industries	Bilha	Nipaniya	6	0
7	shri Kamal Rice Mill	Bilha	Keshla/12	6	0
8	Siddhi Vinayak Rice Mill, Ratanpur	Kota	Hemu Nagar/39	6	0
9	Vijay Rice Mill	Masturi	Pndhi	2	0
10	Maa Bhavani Rice Mill	Takhatpur	Khapri	2	0
11	Kisan Rice Mill	Kota	ratanpur/2	1	0
12	Shri Hanuman Rice Mill	Bilha	Bilha Ward No 4	4	0
13	Kirti Agro mill Pvt Ltd	Bilaspur	Sirgitti, Sector-A	3	0
14	Shri Om Oil Extraction Ltd	Bilha	Sirgitti	6	0
15	Saraswati agro Industries	Bilha	Keshla/12	6	0
16	Shri Ambika Rice Mill	Bilha	Anjani	6	0
17	Hari Om Rice Products	Takhatpur	Anjani	6	0
18	Manish Rice Products	Bilaspur	Khamtrai	1	0
19	Shri Shankar Rice & Oil Mill	Bilha	Keshla/12	4	0
20	Maa Narmada Agrotech	Pendra Road	Madna	6	0
21	Harihar Rice Mill	Pendra Road	Pendra	2	0
22	Dhanlaxmi Rice Products	Bilha	Bilha	4	0
23	Manokamana agrotech Pvt Ltd	Masturi	Khajari, Pandhi	6	0
24	Shri Parvati Rice Mill	Bilaspur	Lingiyadih	6	0
25	Shri Kanhaiya Agro udyog	Bilha	Bilha/05	1.5	0
26	Shri maa Bhavani Rice Mill	Bilha	Nipaniya	3	0
27	Shri Shiv Shankar Rice Mill	Bilha	Ward No 12	4	0
28	J.K.Foods	Masturi	Khada(Dhania)	4	0
29	S.D.Agro Food Products	Masturi	Khajari(Pandhi)	0	2
30	Bhagyshri Rice & Oil Processing Unit	Bilaspur	Sirgitti	0	3
31	Shri Shiv Shankar agro Industries	Bilha	Ward No 12	0	3.6
32	Shreejee Rice Priducts	Bilha	Sendri	0	5
33	Hari Om Rice Mill Pvt Ltd	Masturi	Darrighat	0	8
34	Shri Shyamji Rice Mill	Bilaspur	Mohatari	0	6
35	Sardar Agro industries	Takhatpur	Jareli	0	6

References:

- Adil Elhag Ahmed and Farook Adam (2007) Indium incorporated silica from rice husk and its catalytic activity. Microporous and Mesoporous: 103, 1-3,284-295.
- Ritesh Pandey , Santosh K. Sar and Ashish Kumar Bhui (2012) FEASIBILITY OF INSTALLATING RICE HUSK POWER PLANT IN CHHATTISGARH TO MEET SUSTAINABLE ENERGY DEMANDS: IJAERS/Vol. I/ Issue IV/July-Sept., 2012/57-60
- M.P. Pandey, S.B. Verulkar and A.K. Sarawgi Status Paper on Rice for Chhattisgarh http://www.rkmp.co.in
- S.C Bhattacharya, M. Augustus Leon and Md. Mizan ur Rahman- Energy for Sustainable Development 6 (2) (2002) 67-71
- Quang Nguyen Bui, Nam Minh Hoang and Khanh Vinh Nguyen –Calorific Value and Energy Yield of Refuse Derived Fuel (RDF) from Rice Husk and Plastic wastes: Journal of Science and Technology/Vol. 47, Number 5A, (2009) 396-404
- *Comprehensive Industry Document on Pulse, Wheat and Rice Mills- A Central Pollution Control Board publication, COINDS 2008*
- *Rice Husk, Rice Knowledge Bank Website (www.knowledgebank.irri.org/rkb/index.php/ricemilling/byproducts-and-their-utilization/rice-husk)*
- *Use of Rice Husks as Fuel in Process Steam Boilers (Asia-Pacific Environmental Innovation Strategies (APEIS), 2009 (enviroscope.iges.or.jp/contents/APEIS/RISPO/inventory/db/pdf/0004.pdf)*
- *Jittima Prasara, Comparative Life Cycle Assessment of Rice Husk Utilization in Thailand- A thesis report, RMIT University, August 2009*
- *Rice Milling Manual- International Rice and Research Institute, Manila, Phillipines, 2006*
- Website of United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int
- Website of Central Electricity Authority (CEA), Ministry of Power, Govt. of India www.cea.nic.in
- Chungsangunsit, T, Gheewala, SH & Patu msawad, S 2 004, 'Environmental Assessment of Electricity Production from Rice Husk: A Case Study in Thailand', paper presented to International Conference on Electric Supply Industry in Transition : Issues and Prospects for Asia, Bangkok, Thailand, 14 - 16 January.

IndianOil-CREDA Biofuels Ltd.

Indian Oil Corporation Ltd. along with the Government of Chhattisgarh has taken a step forward towards promotion of bio-fuel through cultivation of biofuel species on revenue wastelands and degraded lands in the State. For this purpose a Joint Venture Company IndianOil-CREDA Biofuels Ltd. (ICBL) got incorporated in February 2009. Indian Oil and CREDA (Chhattisgarh State Renewable Energy Development Agency) hold 74 percent and 26 percent equity.

It has also gained experience in expelling and marketing of crude Jatropha oil and bio-mass to domestic market. The company plans to enter into multiple feedstock based non-edible crude oil, e.g. Jatropha, Pongamia, Castor, etc. for use as feed stocks for bio-fuels, fertilizers and bio-lubricants

Bilaspur University

VISION:

Towards an Excellence through Equity, Access and Quality Education.

MISSION:

- Aspire to translate collective dream of the Community of the region in to reality.
- Create, disseminate and advance knowledge, through instructional and Inter disciplinary and collaborative researches.
- Educate and train the Human Resource persons for the development of the State of Chhattisgarh.
- Advancement of intellectual, academic, cultural and natural resource development for Socio- economic development of the region.
- Appropriate measures to promote quality education in affiliated colleges.