Final Report

Indian Agro and Recycled Paper Mills Association

(New Delhi)




Study on Socio-Economic Impact of Agro Residue Mills

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ANNEXURES

ABBREVIATIONS

$	-	Dollar
%	-	Percentage
&	-	And
@	-	At the rate of
CAG	-	Comptroller and Auditor General
CIER	-	Center for Industrial and Economic Research
Cm	-	Centimeter
CMIE	-	Center for Monitoring Indian Economy
CO_2	-	Carbon dioxide
CPPRI	-	Central Pulp & Paper Research Institute
CVD	-	Chemical Vapor Deposition
e.g.	-	For Example
Etc.	-	Etcetera
Ft	-	Feet
Ha	-	hectare
HHs	-	Households
i.e.	-	That is
IARPMA	-	Indian Agro and Recycled Paper Mills Association
IPMA	-	Indian Paper Manufacturers Association
ISO	-	International Standards Organization
Kg.	-	Kilo Gram
Kms	-	Kilometres
Ltd.	-	Limited
m3	-	Cube Meter
Mm	-	Millimetre
MNES	-	Ministry of Non-conventional Energy Sources
MT	-	Metric Tonne
MW	-	Mega Walt
NA	-	Not Applicable
NHC	-	N H Consulting Pvt. Ltd.

PRA	-	Participatory Rural Appraisal
Pvt.	-	Private
RCF	-	Recycled Fibre
RPL	-	Rana Papers Ltd.
Rs.	-	Rupees
sq.km.	-	Square Kilometer
TMP	-	Thermo Mechanical Pulp
TORs	-	Terms of references
TPA	-	Ton Per Annum
tpd	-	Ton Per Day
U.P.	-	Uttar Pradesh
U.S	-	United State
UK	-	United Kingdom
UNCTAD	-	United Nations Conference on Trade and Development
UNDP	-	United Nations Development Programme
USA	-	United State of America
UV	-	Ultraviolet

CHAPTER ONE
EXECUTIVE SUMMARY

1.1 The Backdrop

In India, there has been tremendous growth of agri-fiber based paper industries during the past three decades. The industry hence not only started contributing to conservation but also added to the farmer's income through purchase of otherwise waste agro-residues. The agro based paper industry in India grew in clusters such as Western U.P., Punjab, Andhra Pradesh, Maharashtra and in scattered form in other states of the country. The development added to the farmer's income in these clusters and deprived of such income to the farmers where the industry did not come into existence. In view of the above, Indian Agro and Recycled paper Mills Association, New Delhi sponsored this study to understand the socio-economic relevance of agro based paper mills in India.

1.2 Scope and Objectives

The study wraps up multiple objectives linked with agro residue availability, procurement and logistics on one hand and the end use pattern on the other. However, the study's prime focus is on use of agri-residue by paper units and measurement of the consequent socio-economic benefits accruing to the farmers. In view of this conceptual framework, the emerging TOR of the study is to:

- Assess demand supply status of agro-residues being used in paper making.
- Quantify usage of agro-residues by pulp and paper industry on cluster basis.
- Analyze end use pattern of agro-residues.
- Establish price-pattern by different end uses.
- Analyze seasonality, storage and supply factors.
- Examine socio-economic benefits to the farmers.
- Analyze livelihood framework and extent of additional income from agro-residues to the farmers.
- Measure level of deprivation to the farmers in the areas where paper units do not exist.
- Explore future demand potential by pulp and paper industry.
- Suggest a road-map for the future to the industry to ensure regular supply of needed. raw material at prices which are remunerative to the farmer.

Quantification of socio-economic benefits accruing to the farmers consequent to the emerging commercial demand for agro-residues from the paper industry clusters or the extent of deprivation where such units do not exist but could viably operate has been a neglected research area which this study probes.

1.3 Methodology Adopted

The study wrapped up the major agro residues being used in paper making i.e. bagasse, wheat straw, rice straw, jute/kenaf/mesta sticks and fibrous grasses such as sarkanda, sawai grass and elephant

grass etc. In order to understand the scenario a triangular approach using secondary, primary research and PRA has been adopted. The geographic average for primary research included districts of Muzaffar Nagar and Pilibhit (U.P.), Sangrur (Punjab), West Godavari (A.P.) Ahemed Nagar (Maharashtra) for clusters with paper mill. The counter clusters without paper mill included the districts of Deoria (.P.), Sitamarhi (Bihar), Madurai (Tamilnadu) and Amrawati (Maharashtra). The survey included a direct interaction with more than 900 farmers, 20 agro based paper mills, 40 transporters, 80 traders, 40other industries, 16 sugar mills and 8 agriculture universities.

1.4 Major Findings

- ✓ Agro residues based paper mills shares 23% of total production of paper in India has tremendous potential to convert waste into wealth.
- ✓ The major concentration are in western U.P., Punjab, Andhra Pradesh, Maharashtra and Haryana.
- ✓ Agro residues under study are also being used as fuel for power generation. Mushroom cultivation, animal feed, thatching and packaging.
- ✓ India recovers 58 Million Ton of rice straw with maximum availability in West Bengal (8.8 MT), followed by Andhra Pradesh (8.0 MT), and Punjab (6.3 MT). Other concentration for rice straw are Orissa, Tamilnadu, Bihar, Haryana and Karnataka.
- ✓ India produces more than 115 MT of wheat straw with highest volume coming from UP (37.7 MT) followed by Punjab (23.1 MT), Haryana (15 MT). Other areas of concentration are Bihar, Gujarat, Rajasthan and Madhya Pradesh.
- ✓ The Indian sugar mills recover about 66 MT of bagasse with highest volume being recovered in U.P. (23.5 MT), followed by Maharashtra (16.7 MT), Tamilnadu (7.1 MT) and the other prominent clusters are Andhra Pradesh, Gujarat, Bihar, Madhya Pradesh and Punjab.
- ✓ The harvestings are mostly done manually excepting in case of wheat and rice being harvested mechanically in Haryana, Punjab, Western U.P., part of Madhya Pradesh, Maharashtra, Karnataka and Gujarat.
- ✓ Manual harvesting cuts the plant from a bottom most portion yielding more fiber of good quality. On the contrary mechanized harvesting this aspect is ignored on cost ground. In process, enormous wealth is lost which other wise would have gone to the farmers.
- ✓ In Punjab and Haryana the straws are burnt right in the field since cost of collection is higher and the farmers want the field ready for the next crop.
- ✓ Jute/kenaf/mesta sticks are mostly used as fuel wood by the farmers, in thatching or abandoned in situ.
- ✓ In Amravati, Maharashtra- more than 75% of wheat straw is used for fodder purposes and upto 10% for compost preparation.
- ✓ In Ahemadnagar, Maharashtra- more than 50% of are burnt and 25% are used for fodder purposes.
- ✓ In Deoria, Muzaffarnagar and Sitamarhi 75-100% of recovered wheat straw are used for fodder.

- ✓ Barnala/Sangrur and Pilibhit 50-75% of wheat straw recovered is being sold to paper mills. In these districts 10-25% of this residues are being used for fodder.
- ✓ In Deoria, Muzaffarnagar, Sitamarhi, and Pilibhit about 85% of rice straw recovered is used for cattle feed and the rest is used for domestic use and compost making.
- ✓ In Barnala/ Sangrur farmers burn the rice straw of about 90% of recovered quantity in the field itself.
- ✓ In Madurai use of rice straw is made for compost making, domestic uses and fodder purposes
- ✓ In West Godavari some quantity of the rice straw is sold to paper mills and rest is used for domestic purposes.
- ✓ About 12% of bagasse recovered is the net surplus with the sugar mill provided they do not have cogeneration facility or distillery or other downstream products to feed. The other end uses of bagasse are mushroom production, biomass based power plants, paper, furfural and composting etc.
- ✓ After multiple use the net available surplus of these residues in India are as follows:
    - Rice straw - 16.2 MT
    - Wheat straw - 2.4 MT
    - Bagasse - 2.6 MT
    - Jute/kenaf/mesta sticks - 0.5 MT

- ✓ The prices of agro residue are lesser by 40-50% in the clusters where there is no paper mill compared to the clusters with paper mill.
- ✓ The total loss to the farmers emerged to be above Rs. 800 crores/ annum in none paper mill clusters.
- ✓ Total quantity of agro residues being used in paper making is 4370 thousand tonnes.
- ✓ Total income to the farmers from Residence Sales to paper mills is Rs.810 crores.
- ✓ Agro residues being wasted due to lack of demand or suitable procurement system is 19,211 thousand tonnes.
- ✓ Disposal of black liquor has been a technically challenged affair. The techniques should find out the ways which are feasible both technically and economically for disposal of black liquor. Such investments will check sickness and closure of several units based on agro-residues.

If the residues available are used for paper making the multiple effect will emerge in following form:

- ✓ 115.9 lakh people can be provided with nutritious food
- ✓ 180 lakh people can avail medical insurance
- ✓ 16.23 lakh number of children can be provided with secondary education
- ✓ 3.24 lakh children can be provided with higher education
- ✓ 8.11 lakh toilets can be constructed in the rural set up
- ✓ 20 thousand of tractors can be purchased.
- ✓ 56.8 thousand ha. areas can be brought under minor irrigation.
- ✓ 81150 number of families can be provided with income generation activities

- ✓ 3.25 lakh number of dwellings can be constructed
- ✓ Rs. 56.81 crores can be generated out of the investments as interest income annualy.
- ✓ Rs. 97.38 cores can be generated from industrial ventures if invested in industry.

CHAPTER TWO
SCOPE AND METHODOLOGY

2.1 The Backdrop

India till recently, harboured a population of more than 210 agro-residue based paper and paper board industry units with a cumulative capacity of around 2.6 million tonnes/annum. Agro based paper industries are found in clusters with visible concentration in western U.P., Punjab, Andhra Pradesh and Maharashtra. The clusters have emerged mainly due to availability of pulpable agro wastes and the market access considerations. Besides, there are also units in dispersed locations in central, northern and southern part of the country.

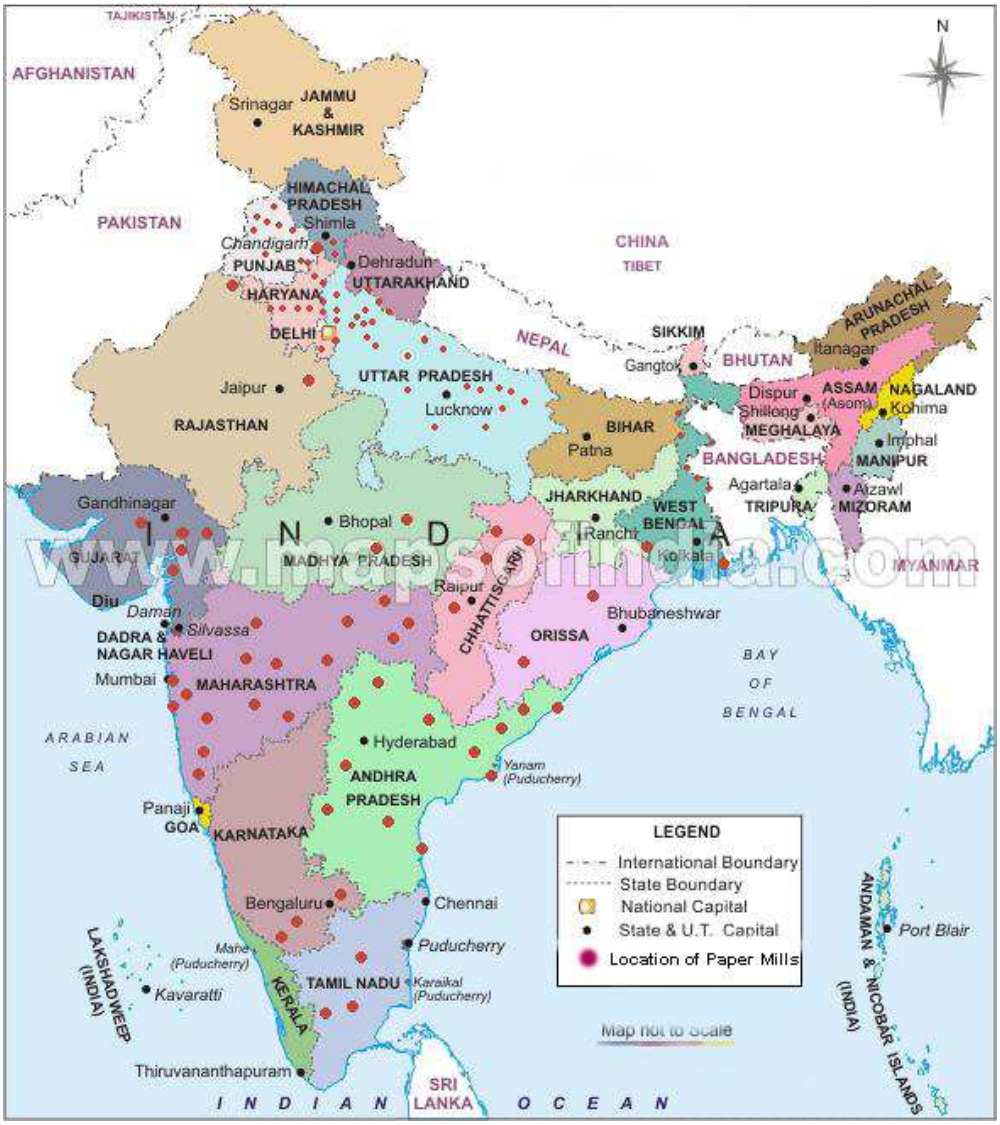

Exhibit-2.01 Agro and RCF Based Paper Mills in India

The major agro based raw materials being used are:

- Bagasse
- Rice straw

- Wheat straw
- Rice husk

Jute, kenaf, mesta and grass crops are also in use but to a limited scale only.

2.2 Relevance of Paper Industry to Rural Economy

An effort has been made in this study to assess the economic relevance of the paper industry to the rural economy which is now increasingly becoming dependent on bio-mass for its raw-material. The industry generates additional farm incomes by procuring agri-residues on commercial terms, provides direct and indirect employment on and off farm, and encourages plantation of tree crops on waste or degraded forest lands. This study quantifies these impacts at the micro (district) level.

The agro-residues i.e. paddy straw, wheat straw and bagasse have regional bias in their end use pattern. There are several alternative uses of these bio-mass which differ from state to state. For example paddy straw is a prime fodder for cattle in Eastern India but on the contrary it is just a waste in the northern region i.e. Punjab and Haryana, where wheat straw is used as fodder. The net surplus scenario guides an entrepreneur to put up a pulping unit near the source of raw material and hence cluster formation.

With innovations in technology for initiation of use of agro-residues as raw material, the supply started being guided by harvest and post harvest management and the market forces. Logistics, procurement management and seasonal availability of these bio-mass are the major problems being faced by the existing units which ultimately results in higher cost of the raw material and in some cases even in periodic closure of mills due to non-availability of these fibrous raw materials. Involvement of middle men in the procurement process is another factor responsible for escalating costs.

With demand emerging from these units for commercial use, agri-residues contribute significantly to farm incomes. However, these gains have not been quantified or studied till now.

There are regions where these materials are still a waste in absence of commercial demand from the industry. In these regions farmers are loosing additional income atleast to the extent of the gain to their counterparts in the region where paper mills exist. The scenario-hence demands for a diagnostic approach not only to study the socio-economic benefits being enjoyed by the farmers due to purchases of their agro-residues by pulp and paper industry but also analyze the market forces which can be instrumental in cross country trade to benefit the farmers in the regions where no such organized demands exist.

In view of an intensive positive link between agro-biomass environment and the paper units, it is believed that the correlation can be further strengthened through an optimization strategy. For the

purpose, it is imperative to understand the socio-economic benefit occurring to the farmers through sale of the agri-biomass to the paper industry. In this context the Indian Agro & Recycled Paper Mills Association, an association of the paper mills based on agro and recycled fibres, thought of a study to ascertain and quantify the socio-economic relevance of agro residues for paper making. For the purpose, it invited proposals from reputed consulting organization vide its advertisement in Business Line dated 13.02.2009. Based on critical evaluation of different technical and financial proposals, the study has been assigned to M/s N H Consulting Pvt. Ltd. (NHC) a leading consulting organization. The study has been conducted by NHC in compliance with the objectives stipulated by Indian Agro & Recycled Paper Mills Association.

2.3 Scope and Objectives

The main objective of the study is to project the raw material requirements of the industry, particularly the segment of agro-residue using units, in a long term perspective and to assess the socio-economic benefits which will flow to farmer communities in mustering the required resources. The reference points for this study were the years 2015 and 2020.

NHC, on award of the assignment, had a brainstorming session of the consultants during which each aspect of conceptual and implementation methodology was discussed. Based on the emerging consensus of the consultants and findings of the preliminary secondary research, an inception report was prepared and submitted to IARPMA. This report set out:

- The TORs of the study
- The study team to be deployed
- The study methodology, and
- The time frame in which various stages of the study was to be carried

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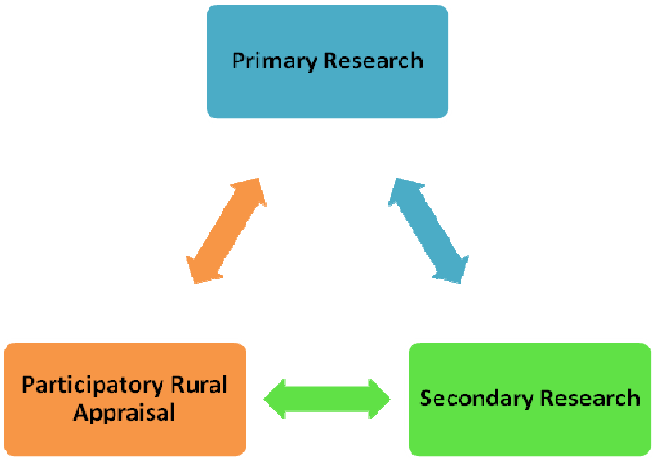
2.4 Approach and Methodology

The study has been conducted through a triangular approach as shown below.



However, considering the TOR, emphasis has been laid on primary research which included two basic tools namely, questionnaire survey as well as PRA. The different dimensions of investigation tools are described in succeeding paragraphs.

2.4.1 Secondary Research

The secondary research exercise attempted to solicit information of macro importance like:

- Identification of industries which use agro-residues mainly bagasse, wheat straw, rice straw, jute/kenaf/mesta stalk etc.
- Identification of the key manufacturers of agri based paper, sugar and other products which use agro-residues as raw material.
- Socio-economic status of farming community in the identified clusters
- Growth plans for end use sectors in the near future
- Production of different agro-residues in the identified clusters
- Area under production of relevant agri-crops (district-level)
- Technological Development concerning to agro based paper making
- Environmental issues
- Demographic profile of the selected clusters

The major sources tapped for the purpose have been:

- Statistics compiled by Indian Agro and Recycled Paper Mills Association
- Statistical compilation of Indian Paper Manufacturers Association
- Statistical publications by Indian Sugar Mills Association
- Annual Reports of identified manufacturing units
- Database of CMIE
- CIERs Industrial Data Book
- In house Data Bank of Consultants
- Statistics available with Indian Trade Promotion Bureau
- News clipping and relevant journals/ magazines etc.
- Publication and bulletins of paper, sugar and power sectors and other sectors using agro-residues.
- Reports/ publication of Ministry of Industry, Ministry of Commerce and Ministry of Finance, Government of India.
- Annual Report of different Industry Associations.
- Journals, magazines and periodicals published by different government, semi-government, autonomous body, private & public sector organizations/ institutions.
- Proceedings of different seminars/conferences including PAPEREX
- Statistic compiled by different paper trader associations
- Information available with different chambers of trade, commerce and industries
- Studies made by UNDP, UNCTAD, World Bank and different International bodies
- Biomass resource atlas, MNES, Govt. of India
- Internet

2.4.2 Primary Research

In order to achieve national coverage, the Indian geography has been divided into major clusters of agro-based pulp and paper units based on their concentration. The major identified clusters are:

- Western U.P.
- Punjab
- Andhra Pradesh and
- Maharashtra

These major clusters have been studied comprehensively through an extensive primary research. For each cluster with existence of paper unit, there has been a counter cluster without existence of agro-based paper industries. The hypothesis has been adopted to examine the comparative scenario of farmers' income through agro-residues in areas where these units exist vis-à-vis the areas where the units do not exist. In other words the clusters without paper units have been chosen on the basis of their richness in agro-residues but without any agro-based paper mill to reflect the comparative advantages/disadvantages emerging through agro-based paper mills. The emerging geographic coverage studied hence are:

With Paper Mill	Without Paper Mill
• Western U.P. (Muzzaffernagar)	• Eastern U.P. (Deoria)
• Punjab (Sangrur)	• Bihar (Sitamarhi)
• Andhra Pradesh (West Godavari)	• Tamil Nadu (Madurai)
• Maharashtra (Ahmadnagar)	• Maharashtra (Amravati)
• Eastern U.P (Pilibhit)*	• Karnataka

(Districts)

** Pilibhit district is the extension of Muzaffarnagar cluster as procurement by Muzaffarnagar paper mills is done from Pilibhit area.*

The major dimensions of primary research are:

i) Targets:

- Farmers
- Traders/middle man of agro-residues
- 1Transporters
- Paper mills
- Other organized end users, major being agro-residues based power plants, mushroom and cattle feed manufacturing units
- Sugar mills
- Institutions like agricultural universities

ii) Mode of research:

- For farmers - Household interviews
  - Participatory Rural Appraisal
- For others - Questionnaire Survey

Exhibit 2.01 shows the PRA conducted in the villages during the primary research.

Exhibit 2.01: PRA Conducted in the Villages

The questionnaires designed and adopted to conduct surveys are enclosed as annexure 2.01 to 2.09 with description as follows:

1. Data format for agro-residue based paper mills 2.01
2. Data format for power plants using agro residues 2.02

iii) Medium of Research:

The primary research has been carried out through pre-designed and tested data format of semi-structured and non-disguised type as mentioned above.

iv) Sample Intensity Achieved

The main target area of this research has been the farmers who are the major beneficiaries of existence of the paper mill in their area. The survey team ensured that almost 100% sample intensity is achieved in the case of farmers survey. During the survey it was revealed that paper mills in Muzaffarnagar buy the straw from Pilibhit district and no surplus straw is available in Muzaffarnagar. Similarly, it was also found out during the survey that the agro residue based paper mills in Ludhiana had closed down for various reasons. On the other hand since Sangrur district in Punjab had some agro residue based paper mills, Sangrur was included in the survey target. The survey, therefore was conducted with 900 farmers in place of earlier target of 800 farmers. The survey intensity achieved hence works out to be 112.50%.

In most of the cases the roles of traders and transporters were found to be overlapping. Almost all traders arranged their own transport services for short distances. Also the transport vehicles varied according to distance and no separate transport charges are billed to the buyer mills. The cost to the mill almost always included the transportation cost.

v) Selection Criteria

The villages have been drawn on following basis:

1. One village near the township/paper mill
2. One village at a distance of 5-6 kms. from the township/paper mill
3. One village at a distance of 10-12 kms. from the township/paper mills
4. One village at a distance of more than 25 kms. from the township/paper mills

(Township means district/tehsil headquarter or a town with more than 1.0 lakh population)

vi) Survey Technique

The survey / interviews were carried out through interactive sessions with the target respondents. The research team comprising trained professionals of NHC, inter-acted with the target respondents

in line with pre-set objectives and as per data format dimensions. The important target segments were handled directly by the senior market research professionals. The extent of crosscheck was to the tune of 20% of the total interviews conducted. The findings hence had confidence level of + 95%.

vii) Analysis Methodology

The data input collected in aforesaid manner has been analyzed through relevant statistical tools. Factor analysis model using multi-variable regression analysis has been used to arrive at the conclusions. The obtained field responses are analyzed through Q-Short method and higher level analysis. A brief description of this methodology is as under:

Q-sort Method

Q-sort technique is the instrumental basis of Q methodology which is applied for rank – ordering of a set of statements from agree to dis-agree. Such statements are taken from interviews and hence are grounded in concrete existence. This comprises of a set of statements presented in following form.

Sort Representing Economic Impact								
-4	-3	-2	-1	0	+1	+2	+3	+4
1	3	10	4	5	2	1	6	20
9	21	13	18	7	14	12	8	24
		22	23	15	1	19		
				16				

In other words, the statement given above states that statement 20 and 24 have been agreed most strongly and 1 and 9 equally dis-agreed. This is further strengthened by relevant indicators. Once they are entered the correlation option are selected followed by the factor analytic option. These options are rotated either by varimax criteria or judgmentally according to theoretical considerations. The factors are displayed graphically enabling visual inspections of the effects through the rotations undertaken. Finally, the factors scores are calculated and applied to the correlation factors matrices as shown below.

Correlation and Factor Matrices									
	Correlations (a)						Factors (b)		
Respondent's Q Sorts	1	2	3	4	5	6	I	II	III
Respondent-I	..	24	30	71	-12	55	X		
Respondent-II	24	..	-18	22	-47	28			
Respondent-III	30	-18	..	34	0	22		X	
Respondent-IV	71	22	34	..	-29	64	X		
Respondent-V	-12	-47	0	-29	..	-10			X
Respondent-VI	55	28	22	64	-10	..	X		

(a) Decimals to two places omitted from correlations.
(b) X = significant loadings; others insignificant.

The revealing output tables are presented through factor arrays which are the real output table comprising of the factors scores indicating the extent to which, each of the statements characterizes each of the set factors.

- **Higher Level Analysis**

Higher level analysis is performed to the data set to accomplish the following objectives.

- Determine which attributes are associated with the associated variables.
- Discover which attributes is the primary determinant of positive feelings about the benefits received.
- Classify demographic groups of the population by whether they tend to accept, reject or be skeptical about the advantages and its impact.
- Isolate various "clusters" of respondents who react similarly to the impacts and are united by demographic and other commonalties.

To meet these goals, the higher level analysis has employed the following tools

- Multiple regression analysis
- Factor analysis
- Higher-level cross-tabular analysis
- Cluster analysis

Execution

The study required a multi-disciplinary team to address the multiple linkage variables of the study. The major subject inputs required to execute the study have been:

- Market Research and Resource Survey Professional
- Socio-economic Expert
- Industry Development Specialist
- Statistician
- PRA Expert and
- Investigators

The interviews have been carried out through interactive sessions with the target respondents. The research team comprising of highly trained professionals of NHC has probed the target respondents in line of the pre-set objectives and data format dimensions. The important target segments have been probed by the senior market research professionals themselves. The crosscheck extents have been to the tune of 20% of the total interviews conducted. The findings hence have confidence level of + 95%.

The data gathered through above sources have been presented, interpreted and analyzed through statistical tools such as time series analysis, correlation, regression etc. The statistical tools have also been applied to crosscheck the authenticity of the data. Sampling or the non-sampling errors have been controlled through systematic supervision and data cleaning exercise. However, extents of 5% non-sampling errors were allowed due to external factors.

CHAPTER THREE
AGRO RESIDUE CHARACTERISTICS AND APPLICATIONS

3.1 Major Characteristics

Agro or crop residues are the parts of plants left in the field after the crops have been harvested, thrashed or processed. Crop residues are good sources of plant nutrients and are the primary source of organic material added to the soil, and are important components for the stability of agricultural ecosystems.

Crop residue is not a waste but rather a tremendous natural resource. About 25% of Nitrogen (N) and Phosphorus (P), 50% of Sulphur (S), and 75% of Potassium (K) uptake by cereal crops are retained in crop residues, making them valuable nutrient sources.

The overall effects of crop residues left on the soil surface on soil functions include:

- Protection from erosive forces;
- Increased or maintained soil organic matter;
- Additions to the available pool of soil nutrients;
- Increased biological activity and improved soil structure; and
- Improved crop yields

The benefits of crop residues to soil quality can be classified into primary, secondary and tertiary effects as indicated here:

Primary Effect

- Contributes to soil organic matter
- Provides physical buffer

Secondary Effect

- Improves chemical, physical & biological properties
- Reduces raindrop impact and wind shear

Tertiary Effect

- Increases yield and yield sustainability
- Reduces soil erosion

Despite the many important benefits of crop residues, research shows their effects can vary. For instance, some reports showed lower yields in systems with high crop residues due to increased disease or poor germination while others reported higher yields when soil moisture is limiting. Some studies suggested that residues do not contribute significantly to soil carbon. Many studies found that additional Nitrogen fertilizer is needed when residues are left on soils to avoid Nitrogen uptake (immobilization) from soil or allow for soil carbon accrual. For appropriate residue removal recommendations, the conditions leading to these varied effects of residues must be elucidated.

3.2 Straw or Stalks- The Major Agro-residue

Straw is an agricultural by-product, the dry stalk of a cereal plant, after the grain or seed has been removed. Straw makes up about half of the yield of cereal crops such as barley, oats, rice, rye, mustard and wheat. In times gone by, it was regarded as a useful by-product of the harvest, but with the advent of the combine harvester, straw posed some disposal problems. However with dwindling stock of wood, straw has again regained its position of premier raw material in number of applications.

Straw is renewable, widely distributed, available locally, moldable, anisotropic, hydroscopic, recyclable, versatile, non-abrasive, porous, viscoelastic, easily available in many forms, biodegradable, combustible, compostible, and reactive. It also has a high aspect ratio, high strength-to-weight ratio, and has good insulation properties (sound, electrical, and thermal). The fibre structure is hollow and laminated, with molecular layers and an integrated matrix.

Table-3.01 shows chemical content and fibre dimensions of several common straws and residues as compared to both hardwoods and softwoods. In general, the straws have less cellulose and lignin than wood, but do contain enough cellulose that they have been considered as a source of pulp and paper.

The ash content of straws varies, but tends to be higher than in wood. The nodes and chaff contain particularly high amounts of ash, and it is desirable to remove as much of these as possible. Typical chemical composition of major straw fibres are shown in Table 3.01.

Table-3.01

Chemical Composition of Some Common Straw Fibres

Type of Fibre	Cellulose (%)	Lignin (%)	Fibre Mean Length (mm)	Dimension (mm) Mean Width	Silica Content (%)
Wheat straw	33-39	16-23	1.4	0.015	4-8
Rice Straw	28-36	12-16	1.4	0.008	10-14
Bagasse	26-39	19-22	1.7	0.020	0.7-3
Jute	61-63	5-13	2	0.020	Less than 1
Kenaf	44-57	15-19	5	0.021	Less than 1
Hemp	55-77	9-13	8	0.030	Less than 1
Corn straw	32-35	16-27	1.5	0.018	-
Coniferous wood	40-45	26-34	4.1	0.025	Less than 1
Deciduous wood	38-49	23-30	1.2	0.030	Less than 1

Source: Hurter Consult

www.paperonweb.com/article/plant-fiber-characteristics.pdf

Straw has been utilized for centuries as a source of paper making fibres. It was a major source of fibre in Europe and North America until the replacement by wood in the early 1920s. The increased labour costs associated with the collection, storage and handling of straw and changes in harvesting methods spelled the demise of straw as a raw material for paper making in the U.S and much of Europe. However, straw continues to be an important pulp and paper raw material in some Eastern European, middle Eastern, and Asian countries. One of the main reasons for using straw for pulp is that it is readily available as residue from food crops.

- **Wheat Straw**

Wheat Straw is a lignocelluloses material containing about 35-40% cellulose, 30-35% hemicelluloses, 10-15% lignin, 5-10% mineral and small amount of other components. Wheat straw has lower ash content than other straws and has a higher potential as raw material for producing pulp and paper products. Straw fibres are similar to hardwood fibres and straw pulp is used in most papers as a substitute for hard wood pulp.

The main advantages of using wheat straw as raw material are its ease of availability and low cost. It has short growth cycle as compared to wood species. It has cellulose content equivalent to wood and has lower lignin content resulting in reduced energy and chemicals use during pulping. How ever, it has some drawbacks also as it contains higher amount of silica and potassium content which makes the recovery of chemicals difficult and also has problems during storage.

The fibres are remarkably uniform and straight with rather thick walls and sharp pointed tapering ends. The fibres vary in length from 600 to 4520 u (average of 1200 u). In width they are very much narrower that bagasse ranging mostly from 8 to 25 u (average or 13 u) and at once serve to distinguish wheat straw from the bagasse.

Compared with the eucalyptus pulp the straw pulps show substantially lower bulk, tear and zero span tensile and are such harder to drain. The scattering coefficient and hence opacity, compared favourably. The straw paper is seen to be lower in tear, zero span tensile and bending resistance than the offset printing paper. However, it is smoother, more closed and more resistant to exposure to UV light.

Overall bleached straw pulp does not appear to have any properties significantly superior to those of bleached eucalyptus pulp except a very low beating energy requirement.

- **Rice Straw**

Rice straw resembles wheat straw and bagasse in the cell types which are present but differs from them chiefly in size of the elements. The fibres are thin and slender than wheat straw but shorter in length. The length varies from 600 to 5200 u (average 1200 u) and width from 4 to 15 u (average 7 u). Rice straw for its fibre characteristics has been found a good fibre for giving bulk to the paper which

is one of the most wanted requirements in Indian paper industry . therefore, a sustainable fibre mix of rice straw should be worked out whenever feasible by its availability.

❖ **Grass Fibres**

As a raw material for paper making, grass fibres are generally slender and shorter and are accompanied by high proportion of fine non-fibre non-fibre cells. In some species the fibre length and width are only about one third that of softwood fibre and the fine non-fibre cell content is about 20 times greater than that of softwood. With these weak points, they are not suitable for high strength papers, but can be used for writing and printing papers. The properties of some grasses are similar to hardwood, species such as bamboo gives better properties than hardwood.

The main grass species used by the Indian pulp and paper industry include Sabai (Eulaliopsis binata), Moonj (Saccharam bengalensis), Kahi (S. spontaneous), and Elephant grass (Themeda cymbania). Of these, Sabai is considered the most important due to its long fibre. Although the pulp quality obtained from the grasses, particularly sabai, is reasonable, their use is generally limited due to inadequate and uncertain availability, difficulties in harvesting and transport, and inefficient (manual) collection. The natural method of regeneration also contributes to the uncertainty of supply, as the yields from natural grassland areas are considerably reduced during drought years.

Some tissues in grass material are harmful in paper making, such as the outer bark and bull of the stalk, the pith cells of bagasse, leaves and reed membrane. They will not only consume chemicals and affect black liquor recovery but also affect paper quality. Therefore removing these constituents from the grass before cooking is advantageous.

❖ **Jute**

One of the major difficulties for use of Whole jute/kenaf/mesta as raw material is with its 95-kg/ m3 chip bulk density which tends to reduce the throughput in the digester. The bulkiness also has negative impact on the transportation cost and the storage area requirement would be substantially high. The solution for managing the bulky raw material is to set up the mother pulp mill in the vicinity of the jute/kenaf cultivation.

The whole jute has both short derived from core wood and long fibres derived from the bast in the desired proportions. The chemical pulps thus made from whole jute do not require addition of neither reinforcing long fibre nor short fibre pulps to improve formation in the paper. The application of enzymes in fibreline operations has shown promising results, which has positive impact by reducing the pulping and bleaching chemical requirement.

The mechanical pulp from kenaf whole plant is particularly suitable for newsprint, which has been successfully tried by American Manufacturing Association with the co-operation from United States Department of Agriculture. The whole kenaf TMP is found to be readily bleachable with alkaline

hydrogen peroxide and the bleaching significantly enhanced strength characteristics of the TMP pulp. CPPRI also demonstrated the suitability mesta to make newsprint. The pilot scale APMP trials at CTP, France indicate its suitability for making good quality newsprint having ISO brightness above 60% .

The potential for growth of paper industry and dearth for good renewable fibrous raw material points to the new sources of cellulose fibres and the prospects for paper pulp from green jute/kenaf are very bright.

- **Sunn Hemp**

Sunn hemp is widely grown in India as a fibre, green manure or fodder crop. Traditionally bast fibres of sunn hemp were used for manufacture of cordage. Due to competition from synthetic fibres and reduced export demand, the use of bast fibre for cordage has declined. However, there has been an increase in the use of hemp for papermaking, particularly specialty papers such as cigarette tissues. As with all other agricultural residues, the heavy cost of harvesting, handling and transport has restricted the use of this fibrous raw material.

- **Cotton Stalks/Cotton Linters**

Both cotton stalks (residues of cotton crop) and cotton waste (clean cotton cuttings from textile mills, first cut linters, mill-run linters, second-cut linters and fluff from cotton mill exhaust systems) can be utilized for paper production. Cotton linter pulps are particularly advantageous for speciality paper grads (filter, laminate, bank note etc.) and cellulose derivatives that typically required high chemical purity. The availability of cotton is restricted since the production is concentrated in few geographical zones.

- **Sarkanda**

Sarkanda, normally a wild grass grows around the water bodies. It has multiple uses ranging from manufacturing of traditional rural furniture to thatching, fencing, rope making and fishing in narrow but flowing nullahas. It is blessed with excellent fibre quality and hence is used in paper making. Limited seasonality precludes its purchase in bulk quantity as inventorization is not possible beyond 30 days due to its quick possibility of fibre loss if exposed to sunlight.

Agro-residue based mills use Sarkanda grass (Saccharum spontaneous) along with rice straw, wheat straw, bagasse, jute/rags in the furnish mix. The use of agricultural residue has grown since the early 1970s partly due to the dwindling bamboo resources and partly due to the government's industrial policy encouraging investments in agro-based paper production. Use of sarkanda not only supplement the fibre need of the unit but also improves textual quality of the finished product.

Sarkanda is also planted through artificial natural regeneration on the embankment of these water bodies to check soil erosion. In both the cases the regeneration is automatic and wild. It attains a very high ground density within one year.

❖ **Bagasse**

Bagasse is the by-product of sugar industry. Bagasse emerges as the residue while sugarcane is crushed for juice extraction either to make sugar or juggery / khandsari. Bulk of Bagasse emerges from sugar mills since the quantity crushed in sugar mills is very high and organized. It is one of the best cellulosic fibres from agro-residue group for paper making.

Physical properties of bagasse include:

1. White and light green in colour
2. It is odourless
3. The typical specific weight is 250 Kg/m3.
4. The main content: 45% moisture, 50 % cellulose- (27.9% hemicellulose, 8% lignin and 11.3% cell contents) & 6% others
5. Energy content: 19400 KJ/Kg dry ash free

Papermaking with bagasse as the major raw material is not free from problems. It has been posing several challenges, to meet the desired paper properties, to meet runnability targets and to meet the cost of production. The environmental friendliness of bagasse, ease of pulping, bleaching and lower pollutant generation have been the advantages of using bagasse. But the short comings of bagasse are short fiber, presence of pith causing deposits and washing problems, finer content, low bulk, low porosity, hygroscopic nature, higher sizing chemical demand, low light scattering power, low tear and low oil/ink absorbency. These drawbacks of bagasse pulp are compensated by addition of wood component and specialty additives and fillers, to meet specific functional requirements of paper.

Bagasse being an agricultural residue, an annual crop, the morphological characteristics of bagasse fiber show that it is inferior to wood fiber with regard to slenderness, collapsibility, bulk and optical properties. Not withstanding, bagasse has certain strengths and certain weaknesses, and certain weaknesses, and utilizing the strengths of bagasse pulp and overcoming the weaknesses with substitutes like wood pulp, fillers and additives has been the normal approach.

Bagasse has potential to be a cheap fibre source because it is concentrated in large quantities at sugar mills and thus the expensive collection and transport stages inherent with most other non-wwd resources are available. The pith fraction is seen to have poor paper with low intrinsic strength and produce sheets with poor optical and mechanical properties for economic and quality reasons it is important to remove as much pith as possible from the bagasse prior to pulping, as the pith not only gives inferior papermaking properties but also consumes large quantities of pulping chemicals and gives a low pulping yield.

Bagasse is released from the sugar mills to the pulp and paper industry in two ways:

- Surplus bagasse, which is released after meeting the energy needs of the sugar mills. The state-owned mills with old boilers hardly yield any surplus bagasse. However, the modern

units in the private sector normally produce surplus bagasse in the range of 5-8%, which constitutes a viable raw material base for small paper mills (<30 t/d).

- Substitute bagasse, which becomes available after replacement by other fuels such as coal, natural gas or fuel oil to met the energy requirements of the sugar mills.

The main constraint with regard to substitute bagasse has been the sugar industry's reluctance to rely on uncertain and increasingly expensive external sources of fuel instead of readily available bagasse. The availability of surplus bagasse at reasonable prices makes it an attractive raw material, but seasonal availability problems make it a difficult for large-size mills to use surplus bagasse, even if it is procured from a cluster of sugar mills within reasonable distance.

Apart from its geographical concentration, the supply of bagasse poses a number of problems, including:

- Transport and storage of bagasse along with its seasonal availability
- Bagasse pulp offers no specific quality advantages over wood pulp. Bagasse has a number of disadvantages including poor strength and drainage properties, low opacity, bulk and porosity
- Problems of chemical recovery and pollution control measures.

Despite its inferiority to wood pulps, bagasse pulp constitutes a realistic and economical alternative to bleached hardwood pulps particularly in printing/ writing paper applications. Bagasse will continue to be an important raw material source for the Indian paper industry until alternative raw materials become available on a sustainable basis.

Agro Residues

3.3 Main applications of Agro-Residues

The major applications of straw have been delineated in the subsequent paragraphs.

❖ **Paper**

Around 5%-10% of pulp and paper worldwide is produced from agricultural crops, valuing agricultural paper production between $5 billion and $10 billion. The most notable of these agricultural crops are wheat straw and bagasse. Paper production is the second largest revenue stream from bagasse after electricity cogeneration; higher than ethanol. Using agricultural crops rather than wood has the added advantage of reducing deforestation. Due to the ease with which bagasse can be chemically pulped, bagasse requires less bleaching chemicals than wood pulp to achieve a bright, white sheet of paper. The fibres are about 1.7 mm long and is well suited for tissue, corrugating medium, newsprint, and writing paper.

Most chemical bagasse pulp mills concentrate the spent reaction chemicals and combust them to power the paper mills and to recover the reaction chemicals.

Detailed analysis of use of biomass in paper industry has been attempted in a separate chapter.

The major uses of straw can be categorised as delineated here:

❖ **Power Plants**

The use of agro-residues in large-scale biomass power plants is becoming mainstream with several facilities already online. Bagasse and risk husk are the most preferred and used residues. However, the recently installed biomass based power plants have also started using any residues including straw and stalks having good calorific value. The residues is either used directly in the form of bales, or densified into pellets which allows for the feedstock to be transported over longer distances. Finally, torrefaction of straw with pelletisation is gaining attention, because it increases the energy density of the resource, making it possible to transport it still further. This processing step also makes storage much easier, because torrefied straw pellets are hydrophobic. Torrefied straw in the form of pellets can be directly co-fired with coal or natural gas at very high rates and make use of the processing infrastructures at existing coal and gas plants. Because the torrefied straw pellets have superior structural, chemical and combustion properties to coal, they can replace all coal and turn a coal plant into an entirely biomass-fed power station.

❖ **Horticulture**

- Straw is used in cucumber houses and for mushroom growing.
- In Japan, certain trees are wrapped with straw to protect them from the effects of a hard winter as well as to use them as a trap for parasite insects.
- It is also used in ponds to reduce algae by changing the nutrient ratios in the water.
- The soil under strawberries is covered with straw to protect the ripe berries from dirt, and straw is also used to cover the plants during winter to prevent the cold from killing them.
- Straw also makes excellent mulch.

❖ **Bedding**

- The straw-filled mattress, also known as palliasse, is still used in many parts of the world.
- It is commonly used as bedding for ruminants and horses. It may be used as bedding and food for small animals, but this often leads to injuries to mouth, nose and eyes as straw is quite sharp.

❖ **Animal Feed**

Straw may be fed as part of the roughage component of the diet to cattle that are on a near maintenance level of energy requirement. It has a low digestible energy and nutrient content. The heat generated when micro-organisms in a herbivore's gut digest straw can be useful in maintaining body temperature in cold climates. Due to the risk of impaction and its poor nutrient profile, it should be restricted to part of the diet.

❖ **Hats**

There are several styles of straw hats that are made of woven straw. Until a century about 100 years

ago, thousands of women and children were employed in plaiting straw for making hats. These days mechanical devices are also employed to make the straw plaits.

❖ **Thatching**

Thatched roofs are becoming increasingly popular for reasons of better insulation properties and economics.

❖ **Geotextiles**

Geotextiles derive their name from the two words geo and textile and therefore, it means the use of fabrics in association with the earth. Wheat straw can be combined with a long fibre such as cotton, jute, flax, or kenaf to form flexible fibre mats. These can be made by physical entanglement, nonwoven needling, or thermoplastic fibre-melt matrix technologies. The two most common types are carded and needle-punched mats. In carding, the fibres are combed, mixed and physically entangled into a felted mat. These are usually of high density but can be made at almost any density.

Geotextiles, both low to high densities, have a wide variety of applications. They can be used for mulch around newly planted seedlings. The mats provide the benefits of natural mulch; in addition, controlled-release fertilizers, repellents, insecticides, and herbicides can be added to the mats as needed. Research results on the combination of mulch and pesticides in agronomic crops have been promising.

❖ **Packaging**

Straw is resistant to being crushed and therefore makes a good packing material. Straw mat sealed in thin plastic sheets can be good packing material. Straw envelopes for wine bottles have become rarer, but are still to be found at some wine merchants.

❖ **Horse Collars**

Working horses are making a comeback, and there is a need for horse collars stuffed with good quality rye straw.

❖ **Construction Material**

- In many parts of the world, straw is used to bind clay and concrete. This mixture of clay and straw, known as cob, can be used as a building material. There are many recipes for making cob.
- When baled, straw has excellent insulation characteristics. It can be used, alone or in a post-and-beam construction, to build straw bale houses.
- Enviroboard can be made from straw.

❖ **Basketry**

Bee skeps and linen baskets are made from coiled and bound together continuous lengths of straw. The technique is known as lip work.

❖ **Sandals**

Koreans wear Jipsin, sandals are made of straws.

❖ **Fuel**

Bagasse is often used as a primary fuel source for sugar mills; when burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare. To this end, a secondary use for this waste product is in cogeneration, the use of a fuel source to provide both heat energy used in the mill, and electricity, which is typically sold on to the consumer electricity grid. The resulting CO2 emissions are equal to the amount of CO2 that the sugarcane plant absorbed from the atmosphere during its growing phase, which makes the process of cogeneration greenhouse gas-neutral.

The cellulose rich bagasse is now being tested for production of commercial quantities of cellulosic ethanol. Biotech approach is being employed to improve ethanol production above and beyond the midwest corn based ethanol production method. This will allow regional cellulosic ethanol production getting around the problem of ethanol transportation. Similarly, rice husk is dominantly being used in boilers of different industries. Even paper mills are using rice husk in their boilers to the extent of its availability.

❖ **Food Containers**

Bagasse is used to make insulated disposable food containers, replacing materials such as styrofoam, which are increasingly regarded as environmentally unacceptable. Insulated disposable food containers made of bagasse are commercially available.

3.4 Conclusions

In view of the aforesaid proportions of agro residues with cellulosic fibre content, it becomes imperative to think whether those should be left in the field as waste or suitably used to manufacture pulp and paper out of it. A holistic approach will not only provide solutions to the environmental linkage with pulp and paper making but also considerably contribute to socio-economic status of the farmers.

CHAPTER FOUR
PRESENT STATUS AND FUTURE POTENTIAL OF AGRO PAPER MILLS

4.1 The Backdrop

Indian Paper industry is the 15th largest paper industry in the world. It provides employment to nearly 1.5 million people and contributes Rs. 25 billion to the government's kitty. The government regards the paper industry as one of the 35 high priority industries of the country.

Over a period of time, besides wood and bamboo, other non-conventional raw materials have been developed for use in the papermaking. The Indian pulp and paper industry is categorized as wood based, agro-based and others like secondary fiber based and also market pulp.

Growth of paper industry in India has been constrained due to high cost of production caused by inadequate availability and high cost of raw materials, power cost and concentration of mills in one particular area. Government has taken several policy measures to remove the bottlenecks of availability of raw materials and infrastructure development. However, in spite of these constraints, paper industry has maintained a high growth trajectory in terms of both, demand and production. The post independence era has experienced a manifold increase in per capita consumption of paper and paper boards. The trend can be seen in Exhibit-4.01.

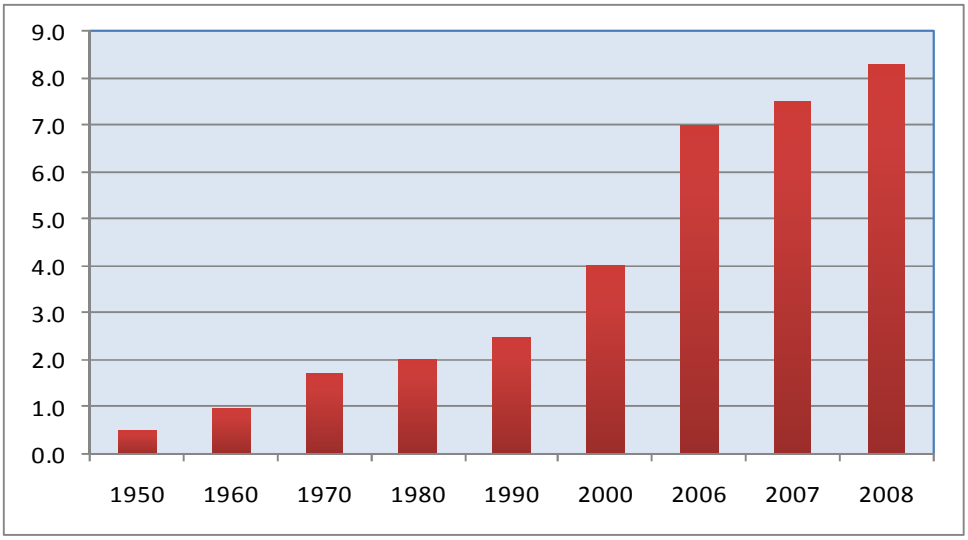


Exhibit – 4.01: Per capita consumption of paper and paper boards in India (kg.)

4.2 Capacity and Production

An overview of the Indian Paper Industry is presented in Exhbit-4.02.

Capacity (Million tonnes per annum)		
Installed Capacity	=	13.0
Idle capacity	=	0.99
Production	=	10.1
Share in Production:		
Wood based	=	30%
Agro-residues	=	23%
Recycled Fiber	=	47%
Industry Structure		
Total no. of registered mills	=	753
Closed (Temporary supervision of operation)	=	97
Mills with capacity above 33 thousand TPA	=	35
Mills with capacity above 20-33 thousand TPA	=	24
Mills below 20 thousand TPA	=	597 (estimated)

Exhibit-4.02: Overview of Indian Paper Industry

There are about 753 units engaged in the manufacture of paper and paperboard in India of which nearly 656 are in operation. The country is almost self-sufficient in manufacture of most varieties of paper and paperboard. Import, however, is still prevalent but confined only to certain specialty papers including coated varieties of paper and boards.

The production of paper and paperboard excluding newsprint during the year 2008-2009 is estimated at above 76 lakh MT. The installed capacity, reported production, import and export of paper and paperboard during the last four years are given in Table-4.01 and Exhibit-4.03.

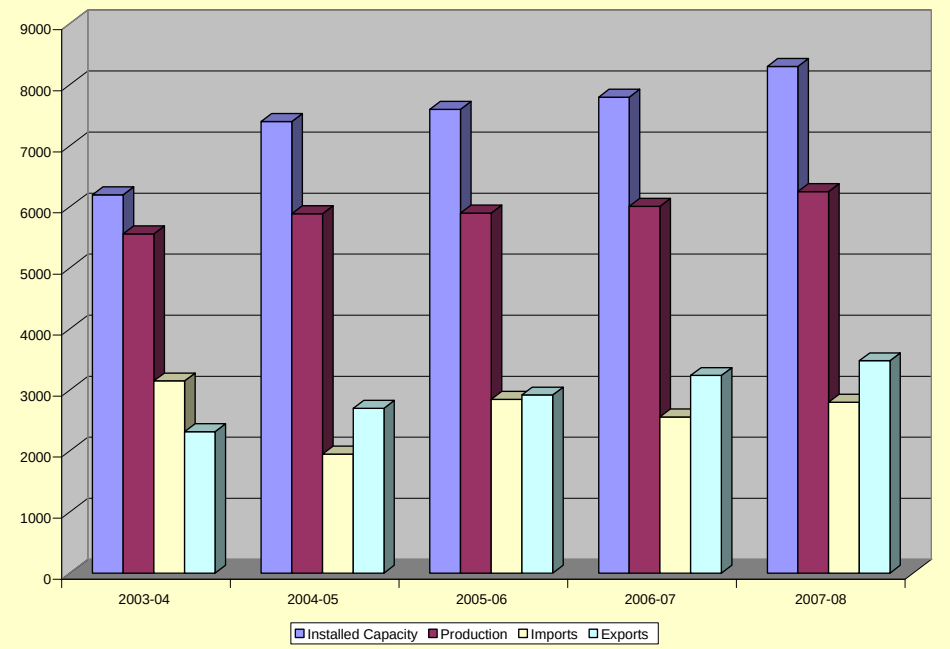
Table-4.01

Capacity, Production and International Trade in Paper and Paper Boards (Excluding Newsprint)

(In Thousand MT)

Year	Installed Capacity	Production	Imports	Exports
2003-04	6200	5560	3150	2320
2004-05	7400	5890	1950	2700
2005-06	7600	5900	2850	2920
2006-07	7800	6010	2560	3240
2007-08	8300	6250	2800	3480
2008-09*	NA	7600	NA	NA

*Source IPMA, IARPMA,CSO * Estimated*



Exihbit-4.03: Capacity, Production and International Trade (Excluding Newsprint)

4.3 Structural Characteristics of the Industry

The Indian paper industry can be divided into four categories:

i)	large-scale (integrated) units	-	50,000 tonnes and up per year;
ii)	medium-scale units	-	10,000 to 50,0000 tonnes per year;
iii)	small-scale agro-based units	-	up to 10,000 tonnes per year;
iv)	handmade paper units	-	60 to 300 tonnes per year

The Indian paper industry consists of small, medium and large paper mills having capacity ranging from 5 to 800 metric MT per day (tpd). The total installed capacity of the paper mills in present context is about 13 million MT of which more than 0.99 million MT is lying idle due to closure or sicknesses. The Indian paper industry has a turnover of more than Rs. 17,000 crore. It contributes to the exchequer more than Rs.2,500 crore annually by way of excise duty, customs duty, CVD, etc. It employs nearly three lakh persons directly and another ten lakh persons indirectly. The concentration of paper units in India is shown in Exhibit-4.04.

Exhibit-4.04: Concentration of Pulp and Paper Units (only major units)

The country is almost self-sufficient in manufacture of most varieties of paper and paper-board. The country imports only certain speciality paper such as coated and cheque paper, etc. which are imported from Singapore, USA, UK, Japan, Germany and Malaysia. Writing / printing grade paper, art paper, coated paper, etc. are exported to neighbouring countries like Sri Lanka, Bangladesh, Nepal and Middle-East countries

4.4 Raw Material Structure

Pulp and Paper industries have been categorized based on the raw material usage. There are three basic categories which are as under:

1. Forest based pulp & paper mills
2. Agro-based pulp & paper mills and
3. Waste paper based paper mills

The major raw materials by above categories are as follows:

Forest based	:	Eucalyptus, Bamboo, Pine, Poplar, Subabul, Pongamania
Agro based	:	Bagasse, Wheat Straw, Rice Straw, Sarkanda, Sabai Grass, Jute / Kenaf etc
Waste paper based	:	Waste Paper

The use of non-wood raw material and waste paper has increased over the years and at present; about 70 per cent of the total production is based on non-wood based raw material. The industrial structure by use of primary raw material is reflected in Exhibit-4.05.

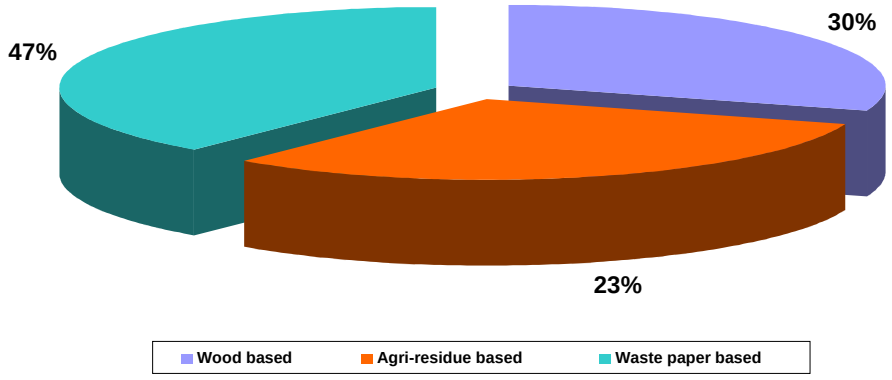


Exhibit-4.05: Structure by Raw Material

4.5 Trend in Capacity and Production

Historically, during 1995-96 – 2004-05, the production has shown a compounded annual growth of about 6.2%. Imports have been clustering around 10% per annum (CAG) as would be seen in Table-4.02.

Table-4.02

Historical Status of Paper, Paperboard & Newsprint in India (Million Tonnes)

Year	1995-96	2001-02	2004-05	2007-08
Production	3.81	5.5	5.9	6.2
Imports	0.42	0.56	0.87	0.98
Exports	0.09	0.13	0.26	0.46
Consumption	4.14	5.93	7.13	6.72

Source: CPPRI and Consultants estimates

It needs to be re-iterated that in India, the industry's capacity ranges between 2 tpd to as high as 800 tpd. Wood based units numbered only 34 but commanded about 30% of installed capacity. The capacity share of forest based units declined drastically from 84% in 1970 to 34% in 2004-05 mainly due to induction and growth of recycled fiber and agro-fiber based capacities. The growth in recycled and agro fiber based capacities can be seen from Table-4.03 and Exhibit-4.06.

Table-4.03

Mill Capacities by Furnish Types (% of Capacity)

Years	1970	2000	*2007*	*2011*
Wood Based	84	39	34	30
Recycled Fiber Based	9	31	28	47
Agro Fiber Based	7	30	38	23

Source: CPPRI and IARPMA

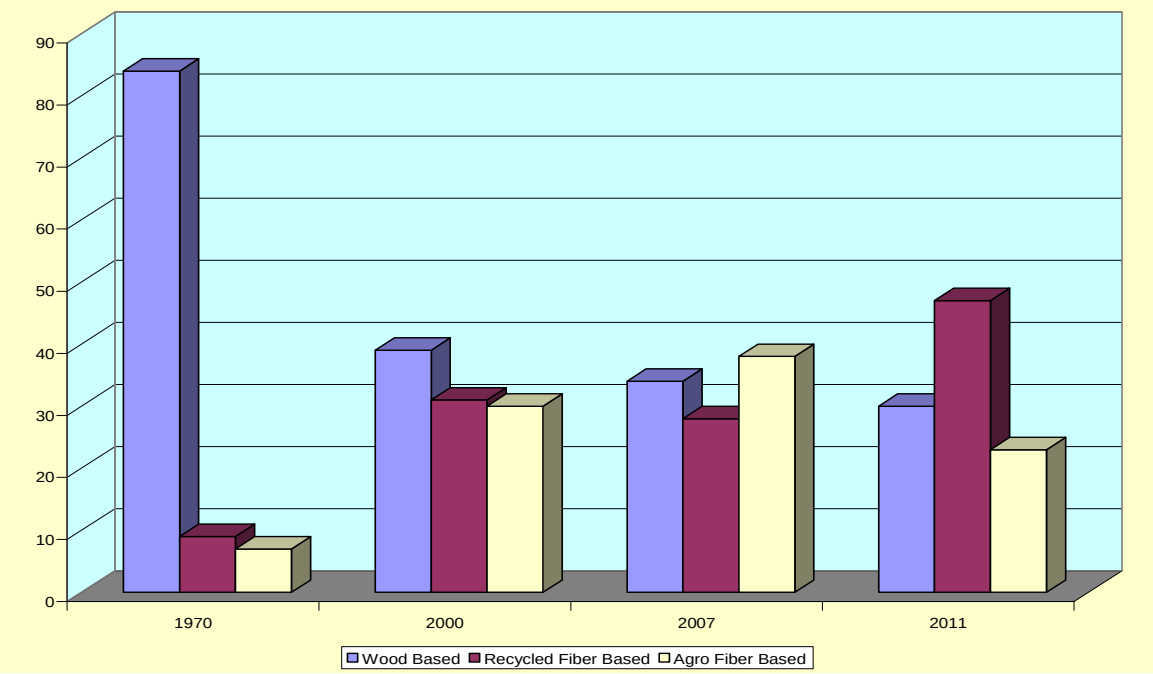


Exhibit-4.06: Mill Capacities by Furnish Types

The major agro-residue based paper mills in India are set out in Table-4.04. The Table also indicates the installed capacities of these mills. The Table also indicates installed capacity, raw materials used and end products along with plant location.

Table-4.04

Major Agro Based Paper Mills in India

S. No.	Name of Paper Mills	Installed Capacity (tpa)
1	ABC Paper	264000
2	Abhishek Industries Ltd.	175000
3	Andhra Pradesh Paper Mill Ltd.	174000
4	Emami Paper Mills Ltd.	145000
5	Shakumbhari Straw Products Ltd.	82500
6	Satia Paper Mills Ltd.	70000

7	Shreyans Industries Ltd.	66000
8	Bindlas Duplex Ltd.	60000
9	Delta Paper Mills Ltd.	51000
10	Shree Shyam Pulp & Board Mills Ltd.	42000
11	Chadha Paper Ltd.	41550
12	Pudumjee Pulp & Paper Mills Ltd.	38500
13	Cheema Papers Ltd.	38000
14	Rana Papers Ltd.	35000
15	Mukerian Papers Ltd.	34650
16	Varinder Agro Chemicals Ltd.	34250
17	Aurangabad Paper Mills Ltd.	33500
18	Kailash Paper Mills	26400
19	Anand Duplex Ltd.	25500
20	Karnal Paper Board Mills	25000
21	Sainsons Paper Industries Ltd.	24000
22	Ruchira Papers Ltd.	24000
23	Amaravathi Sri Venkatesa Paper Mills Ltd.	24000
24	Amrit Paper	24000
25	Kay Pulp & Paper Mills Ltd. Borgaon	23100
26	Sikka Papers Ltd.	22500
27	Shree Bhawani Paper Mills Ltd.	21000
28	United Pulp & Paper Mills Ltd.	20000
29	Rana Mohendra Papers Ltd.	19500
30	Pudumjee Agro Industries Ltd.	18500
31	Sardhana Papers (P) Ltd.	16500
32	The Coastal Chemicals Ltd.	16500
33	Silverton Papers Ltd.	16500
34	Mohit Paper Mills Ltd.	16500
34	Yash Paper Ltd.	16000
35	Madhya Bharat Papers Ltd.	16000
36	Kanoi Paper & Industries Ltd.	15500
37	Dev Priya Industries Ltd.	15000
38	Bindal Papers	33000

Source: www.cpcb.nic.in

The agro and RCF based paper mills in the identified clusters is shown in Table 4.05. Being a fiber deficit country, the industry started experimenting with alternative recycled fibers. Of late, agro-residues emerged to be an answer for the problem. Paucity of forest resources and emerging environmental concerns are restricting over exploitation of forest resources in the country. Procurement and use of recycled fibers have its own problems.

The industry hence started using alternate fiber resources. The agro-based units presently are manufacturing nearly 23% of the total volume of paper and paper boards produced in the country.

The excise, concessions offered to small mills during the 70s facilitated mushrooming growth of small recycled fiber and agro-based units. The demand path was not yet clear and hence 80s experienced an oversupply situation. Resultantly, the capacity utilization went down to the level of 60%. Since then it has been swinging up and down but with beginning of the millennium, the demand started picking up forcing creation of fresh capacities.

Initially, the agro based units were planned with a capacity of 10 to 30 TPD. Typically, those days a 30 TPD mill was defined as a medium size unit. The industry suffered from technology and quality bottlenecks. The agro based units started being identified as polluting industry. Concept of chemical recovery and co-generation was financially not feasible because of its smaller shorter financial size and adverse operational cost. Gradually, the industry started realizing this fact and several such units started expanding their capacity. In present context green field projects are planned with a minimum capacity of 200 TPD. The investment structure for such a capacity takes care of both the aspects and the unit becomes environment friendly and operationally feasible. The situation induced application of low end technology and hence production of high brightness paper and boards kept confined up to wood based units only.

Table 4.05

AGRO & AGRO + RCF BASED PAPER MILLS IN IDENTIFIED CLUSTERS (as per 2005)

S. No.	Name of the Mill	Installed Capacity (tpa)	Raw Material Used	End Products
A) West Godavari, Andhra Pradesh				
1.	Coastal Agro Industries Ltd.	30000	Rice Straw/Bagasse, Waste Paper, Corrugated Boxes	Kraft Paper, Straw Board, Mill Board
2.	Pulavarthy Paper & Boards Pvt. Ltd	3000	Rice Straw	Duplicating Paper
3.	Delta Papers Mills Ltd.	51000	Paddy straw, Bagasse, Recycled waste paper, Pulp	Writing & Printing Paper, Kraft paper, Cream Wove, Duplicating paper
4.	Jayanti Board Mills Ltd.	9000	Straw, Waste paper, Husk	Sign board/ Paper
5.	Aruna Paper Board Mills Ltd.	20300	Rice Straw, Waste paper	Straw board, Writing and printing
B) Ahmednagar, Maharashtra				
1.	Padamashri Dr. Vithalrao Vikhe Patil Sahkari Sakhar Karkhana Ltd	7800	Agro residues	NA
2.	Rajhans Paper Mill	7500	Bagasse, Imported Wood Pulp, Waste Paper	Kraft Paper / Board, Cream Wove, Copier Paper, Writing & Printing Paper
3.	The Pravara Pulp & Paper Mills	7800	Waste Paper, Bagasse, Gunny,	Kraft Paper / Board

			OCC/NDLKC	
4.	The Rahuri Pulp & Paper Mills	9000	Waste Paper, Bagasse, OCC, Imported NDLKC	Kraft Paper
C) Ludhiana, Punjab				
1.	Makin Paper Mills	9000	Waste Paper, Wheat Straw	Note Book Paper, Laminated Paper, Kraft Board
2.	Evershine Paper Mill	1080	Wheat Straw, Imported Waste Paper	Kraft Paper, Kraft Board
3.	Kundan Mill Board & Paper Mills	9000	Waste paper, Wheat straw	Kraft paper
4.	Shreyans Industries Ltd.	66000	Wheat, Rice straw/sarkand, Bagasse, Cotton linter waste, Wood pulp	Writing and Printing Paper, Computer Paper, Duplicating paper, Letter paper
5.	Abhishek Industries Ltd.	1,75,000	Wheat Straw	Creamwove, eco print, ivory white, primeline SSML, crystalline SSML
D) Muzzafernagar, Uttar Pradesh				
1.	Bindals Duplex Ltd.	18600	Waste Paper ,Bagasse, Hessian, Wheat Straw	Duplex Paper, Kraft Paper / Board
2.	Garg Duplex & Paper Mills (P) Ltd.	15000	Waste Paper, Bagasse, Wheat Straw	Kraft Paper
3.	Gold Star Straw Product Ltd.	13000	Waste Paper ,Wheat Straw, Bagasse	Kraft Paper ,Newsprint
4.	Khurana Paper Mills Ltd. Ltd.	1160	Wheat Straw, Waste Paper, Bagasse	Kraft Paper

5.	Maruti Paper Mills (P) Ltd.	9000	Waste Paper, Wheat Straw, Bagasse	Kraft Paper, Newsprint
6.	Rana Papers Ltd.	16500	Sarkanda / Sabai Grass, Wheat Straw, Bagasse, Waste Paper	Kraft Paper
7.	Shalimar Paper Mills (P) Ltd.	10000	Waste Paper, Bagasse	Kraft Paper / Board
8.	Sikka Papers Ltd.	22500	Waste Paper, Hessian, Wheat Straw, Waste Cuttings	Kraft Paper/ Board, Creame Wove, Newsprint, Typing Paper
9.	Silverton Paper	16500	Waste Paper, Rice Straw, Sarkanda	Kraft Paper
10.	Tehri Pulp & Paper Limited	30,000	wheat straw, baggase, sarkanda, waste paper	Kraft paper
11.	Shakumbhri Pulp & Paper Mills Ltd.	10000	Waste paper, Wheat straw	Super deluxe M G Kraft Paper
12.	Babri Paper Mills Ltd.	4200	Bagasse	Kraft paper
13.	Bindal Papers Ltd.	33,000	Wheat straw, bagasse, sarkanda	W&P paper, kraft paper

4.6 Future Scenario

Paper industry has emerged as agro-based industry from its earlier character of forest-based industry. Taking up the challenge of drying up of the raw material resource, paper mills have scripted history by aggressively adopting the agro-residue and social/ farm plantations route. In association with farmers, more than 2.25 lac hectares of mainly degraded land has been brought under pulp wood plantations. This initiative has not only led to generation of large scale employment opportunities but has also helped in greening of India. However, much more is required to be done to develop robust raw material sources keeping in mind the potential of Indian paper industry.

India has emerged as one of the fastest growing paper market globally with growth rates hovering between 8-10 %. However, there is a long way to go. The per capita consumption of paper in India is still amongst the lowest in the world. Therefore, with improvement in education and life style, the demand for paper is bound to grow substantially.

4.7 Demand Projections

In recent years the most acceptable estimates for paper and paper boards made by different agencies are depicted in Table-4.06 and Exhibit-4.07.

Table-4.06

Demand Projections by Various Agencies (mn MT)

Agency	2010	2020
Jaakko Poyry	6.70	14.58
Paperex	8.00	13.00
Paper specialists	8.33	14.85
IPMA	7.93	13.63
Financial Express	8.33	12.20
Mean Value	**7.86**	**13.65**

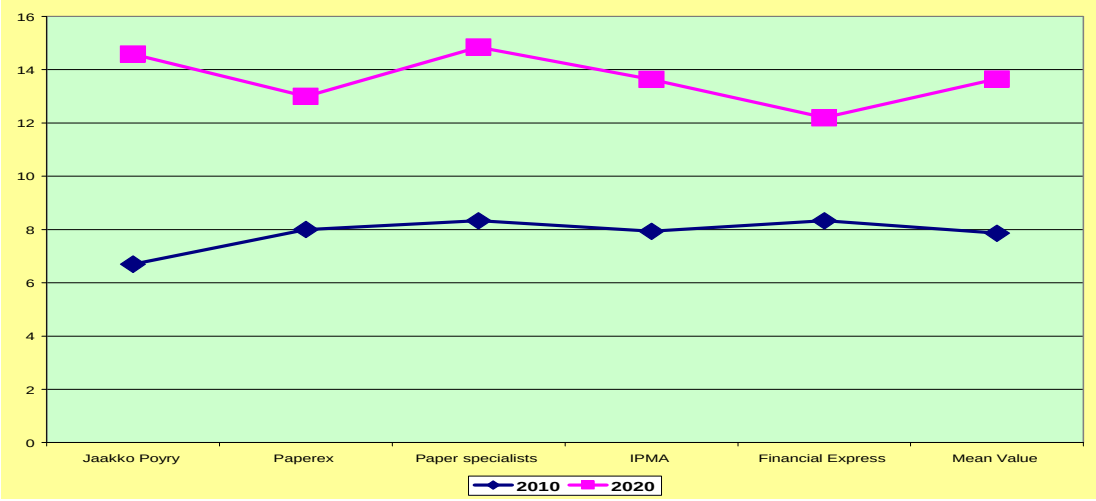


Exhibit-4.07 : Demand Projections by Various Agencies

The Jakko Poyry Country Study was conducted in 2001 and considered the independent variables prevailing that time. The demand driving factors applied were different and hence the indicated demand projection emerged. The projections made by Financial Express considered the independent variables prevailing during the year 2006 and appears to be rather conservative.

India Paper Manufacturers Association is the most informed organization on the paper and therefore, their demand estimates should be taken as more realistic. Paperex estimates as reported was Economic Times in December 2007.

Table-4.07

Demand Projection for Paper and Paper Boards (Excluding Newsprint) in India

Year	Demand (Million Tons)
2007-08	6.60
2008-09	7.06
2009-10	7.56
2010-11	8.09
2011-12	8.66
2012-13	9.26
2013-14	9.90
2014-15	10.60

Source: Consultant Estimates

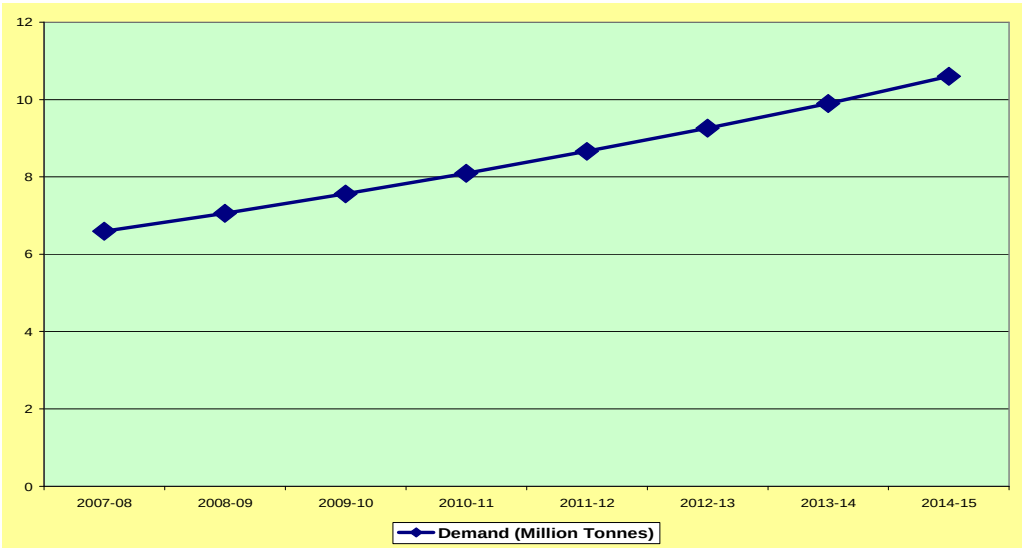


Exhibit-4.08: Demand Projection for Paper and Paper Boards (Excluding Newsprint) in India

It is apparent from above projection that industry will be growing at the rate of 7% despite strong impact of the emerging technologies. Though it appeared that the advent of internet, emails and paperless office concept will bring down the growth in demand for paper and board, on the contrary the scenario became instrumental in pushing up the demand.

The quality of paper used has gone up with certain office equipment not adaptable to low quality papers e.g. fax machine and printers need papers of high quality and specific gsm range only.

In packaging, plastics did substitute some of the paper packages in the beginning but paper packaging is being increasingly used world – wide as plastics are not biodegradable and considered as environmental hazard where as paper is considered environment friendly material. Some of the states, particularly hill states in India, have banned the use of plastic bags.

The Government has undertaken various initiatives to increase literacy such as Mid day meal scheme and Sarva Shiksha Abhiyan with substantial budgetary provisions. Another major demand drive for the writing and printing paper segment is the printing of children's books, exports of which is expected to increase over the medium term apart from domestic demand. Rapid urbanization will also support the growth of this segment.

It is being strongly felt that growth in demand for paper will receive a further fillip with the liberalization and globalization of the economy which have opened up opportunities for industry in multiple ways. Resultantly, the core sectors have been growing at a faster rate than before. There has been sudden spurt in infrastructure and IT sectors in the country. The resulting direct impact has been an increase in both the rural as well as urban income. Expenditure on education has gone high. The industrial sector now is demanding attractive packaging at par with international standards. The printing industry is showing signs of achieving tremendous growth.

While the industry has resilience enough to ride the tough times, it is the threat of cheaper imports that needs to be watched out. With a large number of economies facing slowdown or even recession, large capacities have become idle. The international prices are coming down and a threat to Indian industry which is still battling with challenges such as obsolete technologies and expensive raw material sources.

The slowdown in the global market notwithstanding, India has emerged as the fastest growing paper market in the world showing a 10 per cent growth in per capita paper consumption. From 7.5 kg per capita consumption in 2007-08, the figure has gone up to 8.3 kg. against 324 kgs in USA, 250 kgs in Japan, 37 kgs in China, and 25 kgs in Indonesia.

More than Rs 13,000 crore of capital expenditure is targeted at capacity expansion, modernisation and enhancement of efficiencies by the paper mills in the next two to three years to add more than 3 million tonnes of capacity and improve cost competitiveness.

4.8 Challenges Faced by Agro-based Paper Mills

The major issues faced by agro based pulp & paper mills are:

❖ **Raw Material Availability**

Agro residues are seasonal and hence their availability to the mills is not usually regular. As a results mills have to either create huge storage capacity or use mixed raw materials which in some cases results in adverse impact on product quality as well as process efficiency and cost of production.

Cost of raw materials in India are much higher as compared to other countries as indicated in Table 4.08. The high cost of raw materials has put Indian Paper Industry at great loss and it will make it difficult to compete in the global market.

Table – 4.08

Comparison of Cost of Raw Materials

Country	Cost US$. Tonnes
Indonesia	20
Brazil	26
Canada (E)	31
USA (S)	36
Australia	41
India	60-75

Source: High Powered Committee on Technology

The raw material availability scenario in 2015-2020 is expected to look as indicated in Table 4.09.

Table 4.09

Raw Material Availability (million tonnes of paper equivalent)

	2015	2020
Forest Based	1.50	1.70
Waste Paper	1.00	1.25
Bagasse	0.84	1.18
Others	Neg	Neg
Total	3.34	4.13
Balance	6.66	8.87
Agri Residues required (@2.3 tonnes/tonne of paper)	15.3	20.4

Some of the largest mills in India are based on bagasse as a fibre furnish. Sugar mills usually use bagasse as a fuel for their own power requirements. If a paper mill requires bagasse it often has to supply the sugar mills with an alternative fuel supply. TNPL was the first mill to adopt this policy and there are plans to build at least another two such mills with a capacity of 1,00,000 tpy each within the next five years.

❖ **High Cost of Basic Inputs**

Most of the companies in this sector generally use obsolete technologies and equipments to process agro residues which leads to high consumption of basic inputs like raw material , chemicals, energy , water etc and ultimately affect the overall cost of production. Moreover the average scale of operation of agro based mills vary from 20-50 tpd (except few mills of 100-200 tpd) The low scale of operation coupled with low capacity utilization and high cost of basic inputs results in increased cost of paper production , making it difficult to compete with price of imported paper products.

❖ **State of Art Processing Technologies**

The paper making has now become a state of art technology and the mills due to high scale of operation in developed countries are using most modern technologies and equipment for manufacturing paper. The small pulp and paper mills in India are still continuing with conventional old machines and equipments primarily due to their low scale of operation which makes adoption of these technologies a liability as most of these technologies are capital intensive and of foreign origin.

❖ **Environmental Issues**

The major environmental issues before the small scale agro based mills which are affecting the over all sustainability as well as its competitiveness are summarised as under:

- High effluent volume
- Discharge of black liquor in absence of chemical recovery system
- Discharge of high level of AOX, dioxins & furans in effluents
- High level of pollutants & color in effluents
- Solid waste management / disposal (ETP sludge, fly ash etc)

❖ **High Effluent Volume**

The reduction in water consumption is one of the major issues as these mills consumes high quantity of water primarily due to use of mixed fibrous raw material ,old obsolete equipments and multiple paper machines which results in discharge of high effluent volume .However since last decade mills have started taking all possible actions to reduce the water consumption / discharge of waste water through increased reuse/ recycling of machine backwater / mill effluent within the process. Through these efforts mills have been able to reduce effluent discharge from around 200-250m3 / tpaper to 100 - 200 m3 / tpaper. However recycling of water has limitations due to build up of inorganics and salts, which may affect the product quality & process operations.

❖ **Discharge of Chlorinated Phenolic Compounds**

The small mills producing writing and printing paper use chlorine based chemicals in conventional bleaching techniques. The elemental chlorine is still the dominating bleaching agent and is a major contributor for discharge of AOX. The level of AOX in these mills is generally high compared to large mills.

❖ **Low Efficiency of Pulp Washers**

Due to inherent nature of agro residues as well as use of mixed raw materials, the performance efficiency of the existing pulp washing system is usually below the optimum level leading to discharge of high volume of effluent and high COD carry over along with unbleached pulp. The higher COD carryover in turn leads to high chlorine consumption to achieve the desired brightness level and ultimately high level of AOX.

❖ **Low Efficiency of Effluent Treatment Systems**

In general most of the mills are equipped with adequate effluent treatment facilities consisting of anaerobic lagoon, primary clarifier, aeration tank, secondary clarifier etc. However the performance efficiency of these ETP is usually below the optimum level due to overloading in terms of pollution load due to black liquor discharge and high volume of effluent.

❖ **Solid Waste Management**

Management of solid waste like flyash, cinder, ETP sludge etc will be a major environmental challenge for Indian mills in the coming days. Unmanaged disposal of solid wastes on land leads to detrimental effect on land / soil properties as well as affecting the quality of ground water.

CHAPTER FIVE
OTHER INDUSTRIAL CONSUMERS OF BIOMASS

5.1 Other Bulk Consumers

Apart from paper industry, other major industries which are the bulk consumers of biomass are:

1. Power Plants
2. Mushroom Growers

5.2 Biomass as Source of Energy

Every sector of economy namely agriculture, industry, transport, commercial, and domestic – needs inputs of energy. This has resulted in increased consumption of energy in all forms particularly in the form of electrical energy. This growing consumption of energy has also resulted in the country becoming increasingly dependent on fossil fuels such as coal, oil and gas. Rising prices of oil and gas and potential shortages in future needs to be addressed immediately particularly because increased use of fossil fuels also causes environmental problems both locally and globally.

Promotion of energy conservation and increased use of renewable energy sources are the two objectives which need to be met for a sustainable energy supply. Fortunately, India is blessed with a variety of renewable energy sources, the main ones being biomass, biogas, the sun, wind, and small hydro power.

5.3 Cogeneration in Sugar Industry

The sugar industry across the world has traditionally used bagasse-based cogeneration for achieving self-sufficiency in electricity as well as economy in operations. In India, most sugar mills have been practicing some form of cogeneration. Technologies are now available for high-temperature/high-pressure steam generation using bagasse as a fuel.

The potential for cogeneration projects is estimated at 3500 MW of additional power generation from the country's existing functional sugar mills.

India, today, is perhaps the world leader in the implementation of modern cogeneration projects in sugar mills. The achievements merit attention not only because of the additional grid-connected power generation capacity but also because of the large number of sugar mills, which have implemented these projects. This is noteworthy because of the diverse nature of operating conditions across these mills.

5.4 Biomass-based Power Generation

India produces a huge quantity of biomass material in its agricultural, agro-industrial, and forestry operations. It has been estimated that over 500 million tonnes of agricultural and agro-industrial residue is generated every year. This quantity, in terms of heat content, is equivalent to about 175 million tonnes of oil. Studies have indicated that at least 150–200 million tonnes of this biomass

material does not find much productive use, and can be made available for alternative uses at an economical cost. These materials include a variety of husks and straws. This quantity of biomass is sufficient to generate 15,000–25,000 MW of electrical power at typically prevalent plant load factors.

5.5 Capacity Status

A power-generation capacity of about 1678 MW had been commissioned up to November 2008 with biomass being the main feedstock.

Out of this about 40% is based on biomass and about 60% is using bagasse as principal feedstock. The build up of capacities over a period of last 6 years has been presented in Table-5.01.

Table-5.01

Build Up of Biomass Power/Co-Generation Projects by States (2002-03 to 2008-09)

(In MW)

S.No.	State	Up to 31.03.2003	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	Total
1	**Andhra Pradesh**	160.05	37.7	69.5	12	22	33	9	343.25
2	**Chattisgarh**	11	--	--	16.5	85.8	33.5	9.88	156.68
3	**Gujarat**	0.5	--	--	--	--	--	--	0.50
4	**Haryana**	4	--	2	--	--	--	--	6.00
5	**Karnataka**	109.38	26	16.6	72.5	29.8	8	12	274.28
6	**Madhya Pradesh**	0	1	--	--	--	--	--	1.00
7	**Maharashtra**	24.5	--	11.5	--	40	38.5	41.5	156.00
8	**Punjab**	22	--	--	6	--	--	--	28.00
9	**Rajasthan**	0	7.8	--	7.5	8	--	8	31.30
10	**Tamil Nadu**	106	44.5	22.5	--	42.5	75	18.2	308.70
11	**Uttar Pradesh**	46.5	12.5	14	48.5	--	79	172	372.50
	Total	**483.93**	**129.50**	**136.10**	**163.00**	**228.10**	**267.00**	**270.58**	**1678.21**

Source: http://www.mnre.gov.in/

The biomass materials that have been used for power generation in these projects include rice husk, cotton stalk, mustard stalk, Prosopis juliflora (Vilayati babul), poultry litter, bagasse, cane trash, etc. State-wise distribution of the commissioned and 'under implementation' capacity for biomass based and bagasse power projects is given in Tables -5.02 and 5.03 respectively.

Table-5.02

Capacity Status of Biomass Power / Bagasse Co-generation Project (As on 30.06.08)

S.No.	State	Commissioned			
		Biomass		Bagasse	
		No. of Projects	Capacity (in MW)	No. of Projects	Capacity (in MW)
1	Andhra Pradesh	39	210.20	18	124.05
2	Chattisgarh	18	146.30	--	--
3	Gujarat	1	0.50	--	--
4	Haryana	1	4.00	1	2.00
5	Karnataka	12	81.50	16	180.78
6	Madhya Pradesh	1	1.00	--	--
7	Maharashtra	2	11.50	20	102.50
8	Punjab	2	16.00	2	12.00
9	Rajasthan	3	23.30	--	--
10	Tamil Nadu	12	119.00	17	179.00
11	Uttar Pradesh	--	--	26	352.50
	Total	**91**	**613.30**	**100**	**952.83**

Source: http://www.mnre.gov.in/

Table-5.03

Capacity under Implementation of Biomass Power/Bagasse Cogeneration Project (As on 30.06.08)

S.No.	State	Under Implementation			
		Biomass		Bagasse	
		No. of Projects	Capacity (in MW)	No. of Projects	Capacity (in MW)
1	Andhra Pradesh	3	16.00	10	107.71
2	Assam	1	10.00	--	--
3	Chattisgarh	17	160.80	--	--
4	Karnataka	6	41.50	16	198.78
5	Maharashtra	14	138.50	15	147.80
6	Punjab	4	46.00	4	71.00
7	Rajasthan	5	44.50	--	--
8	Tamil Nadu	9	72.00	6	75.00
9	Uttar Pradesh	1	15.00	63	859.80
10	Uttranchal	--	--	2	30.00
11	West Bengal	2	16.00	--	--
	Total	**62**	**560.30**	**116**	**1490.09**

Source: http://www.mnre.gov.in/

Above tables clearly indicate that there is tremendous growth in the sector. The capacity has grown almost 4 times during the last 6 years. In the coming year the capacity is likely to grow at faster rate than before.

2 quintal of bagasse which is generated from one tone of cane crushed generates 100 KwH of electricity. To generate 1006 MW of electricity 2010 tonnes of bagasse is required which is presently being used by the sugar mills in their cogeneration power plants considering that the cogeneration plant runs for 24 hours a day for 300 days a year the total bagasse utilization calculates to about 7243 thousand tones.

5.6 Power Projects in Identified Clusters

The biomass based power projects in the identified clusters are presented in Table-5.04. West Godavari district of Andhra Pradesh and Muzaffar Nagar in Western U.P. have the maximum number of power projects. Among identified clusters, Deoria in Eastern U.P. and Sitamarhi in Bihar do not have any power plant.

Table-5.04

Biomass Based Power Plants in Identified Clusters

S. No.	Name of Developer	Installed Capacity (MW)
A) West Godavari, Andhra Pradesh		
1.	Sri Kalyani Agro & Industries Ltd	4.00
2.	Gowthami Solvent Oils Ltd	2.75
3.	Sai Renewable Power Pvt. Ltd.	3.00
4.	Costal Agro industries Ltd.	4.00
5.	Jeypore Sugars	16.80
6.	Andhra sugars ltd.	3.50
B) Ahmednagar, Maharashtra		
1.	Mula S.S.K Ltd.	16.00
2.	Spark Green energy Pvt Ltd.	25.00
3.	Gammon Infrastructure Projects Ltd.	30.00
C) Ludhiana, Punjab		
1.	Malwa Industries Ltd.	6.00
2.	Green Planet Energy Pvt. Ltd.	14.00

D) Muzzafernagar, Uttar Pradesh		
1.	The Dhampur Sugar Mills Limited.	22.00
2.	Bajaj Hindusthan Ltd.	10.00
3.	Siddeshwari Industries Pvt. Ltd.	2.25
4.	KR Pulp & Papers Ltd.	5.00
5.	Bhageshwari Papers Pvt. Ltd	6.00
6.	Tikaula Sugar Mills Limited.	10.00
E) Madurai, Tamil Nadu		
1.	Auro Mira Bio Energy Madurai Limited	10.00
2.	Servall Engg. Industries Ltd	2.50
3.	Rajashree Sugars	8.00
F) Amravati, MaharasHtra		
1.	MSM energy Ltd.	10.00

To genrate 1 KwH of electricity 1.2 kg of biomass (rice straw, wheat straw etc) is required. To generate 671 MW electricity, therefore, for 24 hours a day for 350 days a year the quantum of biomass requiered is 6762 thousand tonnes.

5.7 Straw for Growing Mushroom

Mushroom cultivation does not require land and can be carried out indoors, using agro-wastes like wheat and paddy straw, cotton stocks, sugarcane bagasse and other kinds of biomass.

Mushroom cultivation is increasingly becoming popular because it not only meets the dietary requirements but also adds to the income of growers with insufficient land.

5.8 Compost for Button Mushroom

Compost is the substrate on which mushroom is grown. The following ingredients are required for 15-16 trays of size 100cmx50cmx15cm:- Wheat straw (chopped 8-20cm long)-250kg, Wheat/rice bran-20kg, Ammonium sulphate / calcium ammonium nitrate-3 kg, Urea-3kg, Gypsum-20kg.

The following ingredients are required for preparing natural compost for 15-16 trays of size 100cmx50cmx15cm:-

Horse dung-1000kg, Chopped wheat straw-300 to 350kg, Gypsum-25kg Poultry manure-100 to 110kg (or 3kg urea).

5.9 Paddy Straw Mushroom

The mushroom takes its name from paddy straw, the straw left over after growing rice, which happens to be the mushroom's favorite habitat. In addition to its traditional growth medium, the Straw Mushroom can also be found growing on many types of vegetable material such as other straws or grasses, compost, and wood piles. Usually the Straw Mushroom is cultivated for consumption on a mixture of cotton fiber and paddy straw.

5.10 Global Scenario

The world production of mushrooms in 2005-06 was around 12 million tonnes and is growing at an annual rate of about 7%. It has been estimated that the demand and production of mushrooms will sustain this growth rate and it may reach 15 million tonnes by 2010, 25 million tonnes by 2020 and 30 million tonnes by 2025 (See Exhibit-5.01).

Presently, Europe, America and East Asia contribute to about 96% of world mushroom production. The six countries, called G-6, consume about 85% of world production distributed among USA (30%), Germany (17%), UK (11%), France (11%), Italy (10%) and Canada (6%), and the balance (15%) is consumed by rest of the world. Per capita consumption in these countries (See Exhibit-5.02) is very high (2 to 3 kg) as compared to 20-25 g in India.

The ranking of mushroom production world-wide is button (31%), shiitake (24%), oyster (14%), black ear mushroom (9%), paddy straw mushroom (8%) and milky/ others (the rest).

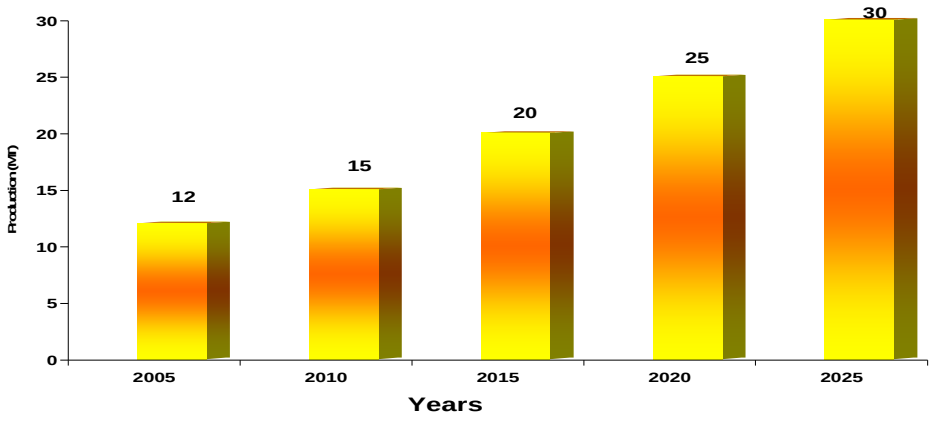


Exhibit-5.01 World Mushroom Production and Projections

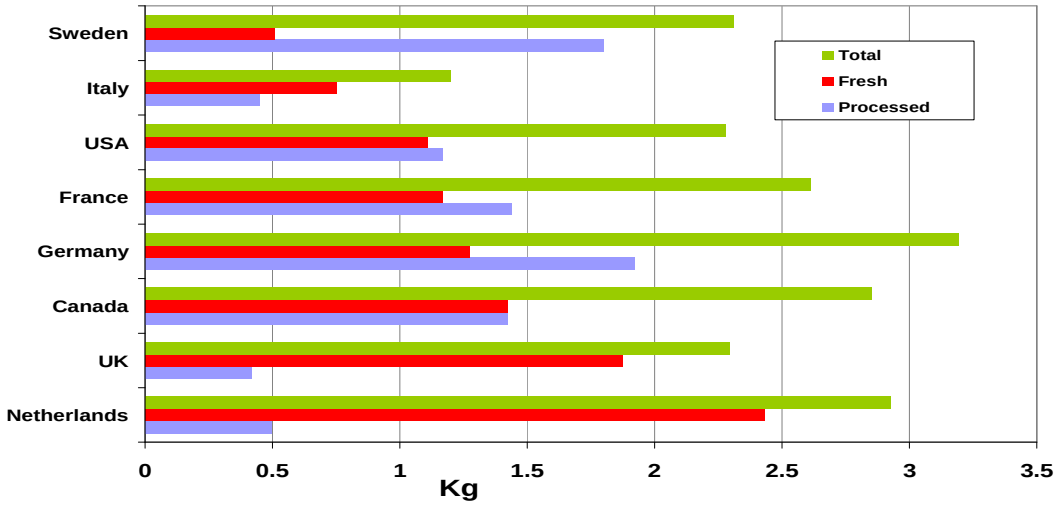


Exhibit-5.02 Per Capita Consumption of Mushroom

5.11 Indian Perspective

Mushroom production in the country was started very late in the 70s but growth rate, both in terms of productivity as well as production has been phenomenal. In seventies and eighties button mushroom was grown as a seasonal crop in the hills, but with the development of the technologies for environmental controls and increased understanding of the cropping systems, mushroom production shot up from mere 5000 tonnes in 1990 to 1,00,000 tonnes in 2006 (See Exhibit-5.03). The present production of white button mushroom is about 85,000 tonnes and the production of other mushrooms is about 15,000 tonnes.

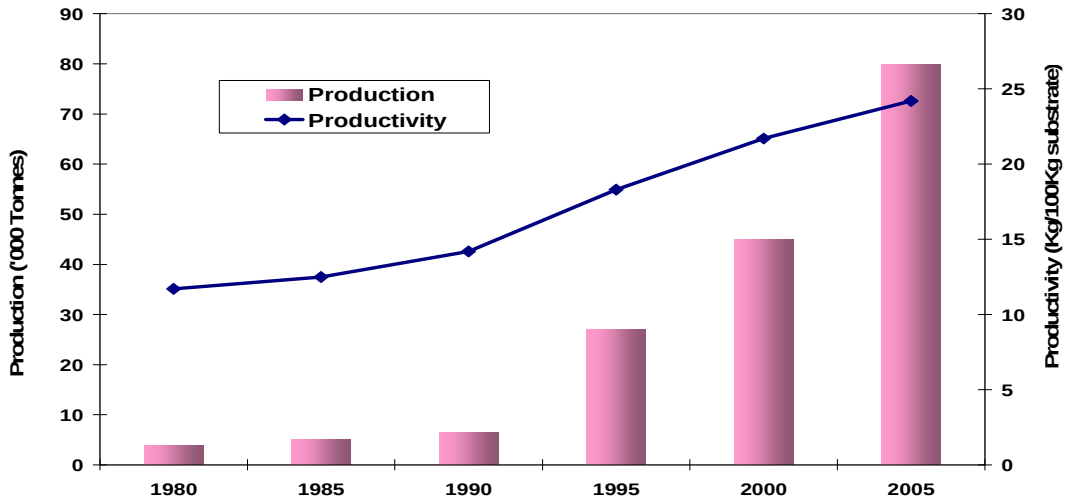


Exhibit-5.03 Growth in Mushroom Production and Productivity in India

To manufacture one tone of mushroom, 1 tonne of wheat straw/ rice straw is required. In 2006 the total mushroom production in India was 1,00,000 tonnes. So to manufacture this 1,00,000 tonne of rice or wheat straw is required which is presently being used in the country.

Several states have been identified which possess good potential for mushroom cultivation on small as well as industrial scale. The current state which has taken a lead in mushroom production is Tamil

Nadu which is likely to multiply its mushroom production from about 10,000 tonnes per annum to at least one lakh tonnes in the next 5 years followed by Haryana, Uttar Pradesh, Uttarakhand, Punjab, Himachal Pradesh and the Jammu region.

Haryana and Uttarakhand are the other leading states where mushroom cultivation is being encouraged and the two states are producing mushrooms of about 15,000 tonnes per annum. The state of Punjab also falls in the same category and the mushroom which is grown in this part of the country is that of Morchela variety which is used for export purpose. Punjab's annual mushroom production is of the order of 15,000 tonnes.

At present, button mushrooms are being produced commercially using wheat and paddy straw and sugarcane bagasse as the base substrate. Of the 35 available species of oyster mushroom, only about a couple — Pleurotus sajor caju and Pleurotus florida are popular for commercial production.

However, cultivation of milky mushroom is also picking up in different parts of the country, especially in southern states. Paddy straw mushroom, another tropical mushroom, is mainly being grown in coastal states, notably Orissa.

The demand side factors are quite favourable for further growth of mushroom output. Abundant availability of agro-wastes, diversified agro-climate and cheap manpower provides large potential for mushroom production in India. It offers an opportunity for employment and income to a large number of rural and urban households.

The country is likely to cross 2.5 lakh tonnes by 2010. Even if slight deceleration in growth rate in India is predicted, a production target of 5 lakh tonnes by 2015 and 10 lakh tonnes by 2020 and 20 lakh tonnes by 2025 is achievable as depicted in Exhibit-5.04.

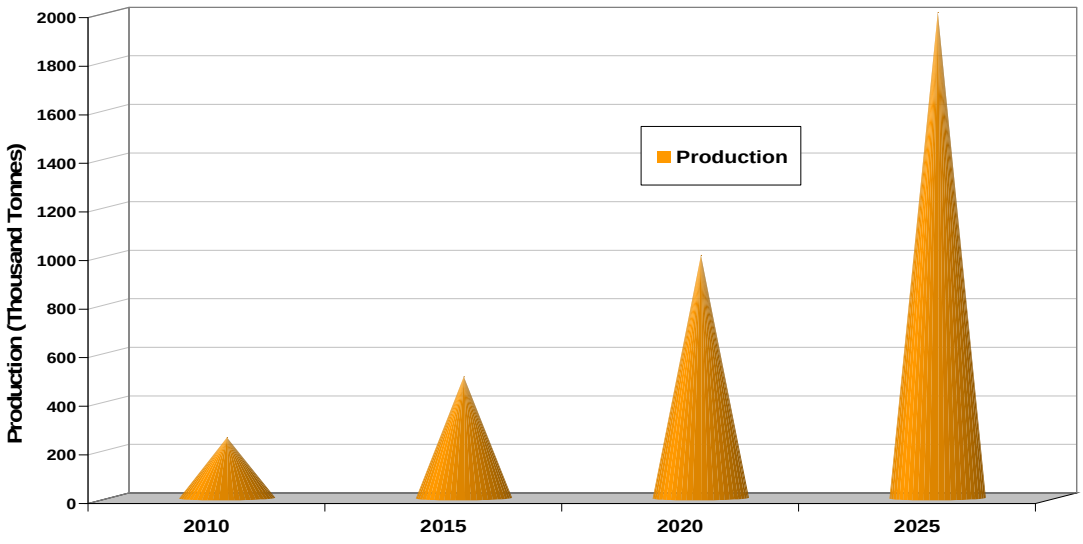


Exhibit-5.04 Projections for Mushroom Production in India

Assocham has indicated that in the next 5 years, out of 2000 known edible mushrooms variety grown worldover, India's mushroom cultivation variety will reach at least 700 from the current species variety of 280.

India's exports of mushrooms during the period 2002-03 to 2005-06 has registered a steady growth of 106.7% in 2005-06 over the year 2003-03 when it reached a level of Rs 138.48 crore in 2005-06 as against Rs 67.28 crore in 2002-03. According to Agri Division of Associated Chambers of Commerce and Industry of India (Assocham) mushroom exports is likely to touch Rs 170 crore by 2010.

CHAPTER SIX
SURVEY ANALYSIS AND FINDINGS

6.1 Survey Design

As elaborated in the Inception Report, surveys of agro residue consuming industries, farmers, traders, transporters of agro residues and PRA of villages falling in target districts of the study, were conducted. The information gathered from these interactions has been analysed and used in arriving at various norms and inferences which have been included in the report at appropriate places. However, out of the lot, two surveys have been of utmost importance because of their relevance to the main objectives of the study. These include:

1. Survey of paper mills in the identified clusters
2. Survey of farmers in the identified villages
3. PRA of sample villages in the identified clusters

6.2 PRA of Sample Villages

The responses from village level PRA have been delineated in the following paragraphs.

- **West Godavari District, Andhra Pradesh**
  - **Kanchumarru**

The village is situated in Attili tehsil of West Godavari district. It has total geographical area of 700 acre and total cultivated land of 500 acre. There are approximately 515 families in the village.

In the village around 95% families are landless labourers. But 50 household have lands. Among them 25-30 households have land holding size of more than 10 acre even some farmers have lands upto 70 acre. Around 70% of the lands are leased out to the landless labourers. Other households are agricultural labourers or working is small scale business viz. selling vegetables, managing kirana shops or fish cultivation.

The main crop grown here is rice with two time cropping. The average production of rice per acre is 15-20 quintal and average per acre rice straw recovery is 8-10 quintals. The rice straw is mainly sold to the paper mills. About 50% straw recovered is sold to the paper mills, 30 % is used for compost and 20% is used for fodder purposes. The agents of the paper mills or the traders come to the villages to collect the rice straw and the price is negotiated on the land. The prevalent rate of rice straw is Rs.300-500 per acre considering the straw recovery to be around 1 tonne. However depending upon the production of rice straw due to external factors, the straw price keeps on fluctuating.

The residues are transported through tractors. The farmers are paid immediately by the traders and in some cases with 1 or 2 days delay. There is no system of advance payment in straw trading here. Some farmers also sell the straw for fodder to other farmers. The farming is done manually. There are 7-8 tractors in the village. The rental paid for hiring the tractor is Rs700 per acre. The harvesting is done

through bullocks or tractors. Mainly the straw selling takes place on and just after the harvesting season because firstly there is no facility for storage of straw in part of farmer and if he stores the straws in the open space the quality of straw corrodes for paper making. Some farmers with storage facility holds the straw for 3-4 months after harvesting season is over and sells to the paper mills at a higher rate. Mainly the off season sale of straw is made by the farmers having large landholdings of above 5 hector and proper storage facility.

- **Relangi:**

The village is situated in Iragavaram taluka of West Godavari district. The village has a total geographical area of 1500 acre of which 900 acre is used for cultivation. The village has 3346 households. The village has mostly landless labourers who cultivate the lands on rent. Only 8-9% people have land. Other households have their earning through business or agricultural labour. There are around 200 cows and 500 buffalos in the village with negligible population of on the animals.

Rice is the major crop in the village. Manual cultivation and harvest practice is in place in this village. The per acre production of rice is 15-20 quintal and that of rice straw is 8-10 quintal. The farmers sells the rice straw to the paper mills. The cost of the straw per tonne is Rs300-Rs.500 which is calculated on pear acre basis considering the straw production to be 1 tonne per acre. The farmers are paid immediately and negotiation takes place on the place of purchase.

In the village 50% of the straw is sold to the paper mills and the rest is used for either household purpose or for fodder.

- **Korukollu:**

The village has the geographical area of 1100 acre and a cultivated land area of 800 acre. It has around 1300 no of households mainly landless. Only 5-8% people have land with individual land holding size even up to 70-80 acres.

The main cultivated crop is rice with a production factor of 18-22 quintal per acre. The residue generated per acre is 1 tonnes. The farmers sell the major portions of the residues generated to the paper mills and use a little amount either for household or fodder.

The price of the rice straw is negotiated on place and time of sale and residues are carried to the paper mills through tractors by the traders or agents of the paper mills. There is no system of advance payment in rice straw trading. The rice straws are not hoarded to be sold later at a better price because of the problem of storage. However the paper mills have their own storage system and hence collect the residues immediately after the harvesting season at a lesser price.

According to one farmer, he uses the earnings from sale of straw towards its daily expenditure and farming purpose. The farmers confirmed this to be an additional income for them. The farmers who take lands on rent and depend mainly on agricultural income consider this to be contributing to their

economic well being to some extent. However, the farmers opined that they use this additional income towards their over economic benefit not specifically towards education or health or social occasion.

- **Komarda**

Komarda is situated in Bhimavaram tehsil of west Godavari district. The village has a geographical area of 600 acre and cultivated area of 450 acre. It has 100 families of which 90-95% are landless. The landless families have their source of income from agricultural labour, small scale business, fishery, factory labourers, coconut cultivation and coconut selling.

In the village 50-60 families have lands. 8-10 families have land more than 10 acre and 40 people have average land holding of 6-8 acre.

The main crop cultivated in the area is rice with per acre production of 1.8-2.2 tonnes. Per acre rice straw production is 1-1.2 tonnes. The village has 15 tractors. The rental charged for hiring the tractor is Rs.700 per acre. The farming is done manually. Very recently mechanical harvesting practice is introduced. The rice straw here is mainly used for fodder and household purposes. Around 30% straw is used for fodder , 20% is used in households and 50% is sold to the paper mills. Generally the agent of the paper mills come to village to collect the residue and pays direct cash to the farmers at Rs.300-Rs 350 per acre considering the production of straw to be one tonne. Actually the traders negotiate on acre basis. Sometimes the prices go upto Rs.500 per acre. The residues are transported through tractor.

- **Ahemadnagar District, Maharashtra**
  - **Pimplas**

The village has around 320 households of which 10% are landless labourers. 60% people have more than 2 acre and 30 have less than 2 acre land. Few farmers have more than 5 acre land. The total cultivable area in the village is about 350 hector. The cattle population is around 1300. Buffalo population is very less in the village. The main crops grown in the village are wheat, sugar cane and cereals. In around 25% of the cultivated village land sugar cane is grown and in 30% area wheat is grown. The cultivation of wheat is dependent on rain as irrigation facility is not available in the village. The per acre productivity of wheat varies from 12-14 quintal but very few people with improved cultivation practices get 15 quintal or above production per acre.

There are 8 tractors, 7 threshers and 8 trailers in the village. Rs. 1000 per acre is charged for hiring the tractor. Rs. 80 is charged for one bag of 100 kg. of wheat threshed or one bag of wheat straw recovered considering 80-100% wheat straw recovery. Per acre Rs.700 is charged for hiring the trailer.

The end use pattern of what straw in the village are 20% in compost/manure preparation, 30% for fodder and 50% is burnt in the field or wasted. There is no selling of wheat straw to paper mills or any other industries. Only very few people sell to other people for fodder purposes.

- **Dahigaon Korhale:**

There are 550 households in this village where 40% landowners have less than 1 hector land, around 45% have 1 to 2 ha land and 10% have more than 2 hector land. The remaining are landless labourers. In the village the cow, bullock and goat population is more.

The village has around 550 hector of cultivated area in which around 20% land is used for cultivation of wheat followed by sugarcane. The other crops cultivated are cereals, grapes and some kind of fruits. Per acre production of wheat is 10 quintal to 14 quintal depending upon the water availability. This year the villagers have grown wheat in substantially less lands.

The village has 9 tractors equipped with trailers. There are 6 threshers and one combine harvester and Rs 800 is charged for a tractor for one acre of land and Rs.800 is charged for trailer for one acre. For hiring one thresher Rs.100 is charged for threshing one bag of wheat with 100 kg. capacity. The combine harvester is hired for Rs. 800 per acre.

The villagers use 20% of the generated wheat straw for fodder, 20% for compost preparation and waste the rest 60%. There is no system of sale of wheat straw to any plant or any industry. Only paltry amount of wheat straw is traded for fodder purposes. Very occasionally traders appear for wheat straw for mushroom industry or dairy farms @ Rs2000-Rs2500 per tonne. One villager who used to sell wheat straw to the paper industry and mushroom industry 6 years ago recounts that Rs.1000-1200 per tone was charged for the wheat straw and that was supplied to the Pravara Pulp and Paper mills and Rahuri Pulp and Paper mill.

- **Astagaon:**

The village has total geographical area of 23 sq. km. of which 320 ha land is used for cultivation. The village is the dwelling of 870 households. In the village 20% households are landless, around 35% have land upto one hector and rest have land more than one hector with very few people having more than 2 hector land. The cow population is more in comparison to goat population, which is around 1200-1500 in nos. The main crops cultivated in the village are wheat and sugarcane. Around 150 ha is used for wheat and 75 ha for sugarcane cultivation. The farmers sell the sugarcane to the sugar mills in the Ahemadnagar area. Per acre production of wheat is 10-12 quintals with equal or little less amount of straw recovery.

There are 12 tractors, 9 threshers and 12 trailers in the village. The farmers pay Rs.900 for hiring the tractor for one acre, Rs.800 per acre for hiring the trailer and Rs.90 is charged from the farmers for threshing one bag of wheat. Mainly the farmers waste or burn the wheat straw. Only 20% of the straw recovered is used for fodder and another 20% is used for compost/manure preparation. While the rest 60% is destroyed or wasted. There is no practice of selling of wheat straw to any paper mill or any plant. Sometimes from Nasik town traders come to collect wheat straw for dairy farms but the frequency is very little.

- **Rahata:**

Rahata village has 2200 households with a total geographical area of 37.84 sq.km. it has total cultivated area of 700 ha. More than 400 households have 1-2 ha land, 300 households have less than 1 ha and around 1200 families are landless. As the Rahata town is in this village, the migrant population is more and hence more number of landless farmers dwell here who depend upon non farm income for livelihood. The village has 2500 no of cows and around 1500 no of bullocks with equal no of goats and other pet animals. The buffalo population is very less in the village. The village has around 350 ha wheat cultivated land. and 100 ha of sugar cane growing land.

The per acre wheat production is 12-15 quintal and a good harvest gives a production of 18-20 quintals per acre. The per acre wheat straw production is 8-13 quintal.

There are 55 tractors, 40 threshers and 55 trailors in the village. The tractor is rented out for Rs900 per acre, thresher for Rs80 per bag of wheat threshed and trailor for Rs 700 per acre. Around 70% of the wheat straw generated is wasted and 20% is used for fodder purposes . The rest 10 % is used for compost. The villagers are not selling the residues to any paper mill or any other industry.

- **Muzaffarnagar District, Uttar Pradesh**
  - **Chandpur**

This village falls under Muzaffarnagar tehsil of Muzaffarnagar district. The nearest paper mill to this village is Bindl duplex, Siddheswari, Bindal Papers and Garg Duplex. The village grows sugarcane and wheat. This village has a total geographical area of 1200 acres of which 1000 acres are cultivable land. There are 500 no of families in this village with a total cattle population of 1000 and 1200 buffalos. 30% of the households are landless families. The majority of families (160 nos) have a land holding of 2-5 ha. Around 100 families have land holding of 1-2 ha. only 10-12 farmers have more than 5 ha. land. the population of farmers with less than 1 ha. land is 50.

There are 110 tractors and 10 threshers in the village. The average annual rice and wheat production is 100 tonne and 1000 tonne respectively. The annual wheat straw production in the village is 1000 tonnes. The wheat straw is mainly used for fodder purposes and the farmers does not sell wheat straw to the paper mills. There are few farmers with higher land holding who sell wheat straw to the paper mills. The wheat straw price is Rs.2000-2100 per tonne. The farmers with kolhu bagasse sell to the paper mills at Rs.1000 per tonne.

The farmers selling wheat straw or bagasse sells through traders due to easy payment system. The paper mills do not purchase directly from the farmers rather through traders.

- **Gomatipur:**

This village is situated in the Shamli taluka of Muzaffarnagar district. The village has 800 acres of cultivable land out of total geographical area of 900 acres. The village houses 600 families of which 40% families are landless, 40% have land less than 1 ha and rest 20% have land holding of 1-5 ha. The

village has total 500 cows and 200 buffalos. The major crops grown in the village are wheat and sugarcane.

There are 50 tractors, 4 threshers and 45 tractor trolleys in the village. The total annual wheat production in the village is 600 tonnes and that of sugarcane is 3600 tonnes. The wheat straw production is also 600 tonnes per annum.

The farmers do not sell wheat straw to the paper mills.

- **Mikhayali**

This village is in the Muzaffarnagar taluka of Muzaffarnagar district. The nearest paper mill from this village is at 4 km distance. The village has a total geographical area of 500 acres (2500 bigha). The cultivable area is 400 acres.

Wheat and sugarcane are mainly cultivated in this village. The village has total 1000 families of which 600 are landless. Majority of farmers have a land holding of less than 2 ha. The buffalo population of the village is more than the cattle population. There are 3000 buffalos and 2500 cow and bullocks in the village.

Total annual wheat, rice and sugarcane production in the village are 150 tonne, 500 tonne and 2000 tonnes respectively. The village has 200 tractors and 25 threshers. The thresher renting system in the village is for every quintal of wheat threshed 10 kg wheat is given out.

The farmers in the village do not sell wheat straw to the paper mills. The annual wheat straw production is 500 tonnes in the village. Wheat straw is used by the households for fodder purposes except small quanities are wasted or used for compost making. Very few farmers with landholding of above 4 ha have surplus wheat straw which they sell to the paper mills at Rs.1900-2000 per tonne.

Though there is a demand for wheat straw in the area by the paper mills, due to fodder use and other domestic use the surplus is not available to be sold to the paper mills.

- **Mahabatpur**

This village is located in the Shamli taluka of Muzaffarnagar district. The total geographical area of the district is 250 acres of which 180 acres are cultivable land. The total number of households in the village are 175 of which majority (60%) of farmers have land holding of less than 1 ha. , 50 are landless farmers and 25 farmers have landholding of more than 2 ha. The total cattle and buffalo population in the village is 300, buffalos being highest.

The village has 25 tractors and 3 threshers. The total annual wheat and wheat straw production are 180 tonnes each. There has been no system of selling of wheat straw to the paper mills except few people selling that. The households use wheat straw mainly for fodder purposes apart from using a small quality for compost preparation and other household purposes.

❖ **Amravati District, Maharashtra**

➢ **Fulamla:**

Fulamla is a village in Nandgaon Khandeshwar of Amravati district. The total geographical area of the village is about 9 sq. km. and total cultivated area is about 700 acres. There are 400 families living in the village. The main occupation of the villagers is farming. Most farmers in the village have land holding within 1 to 2 hectares. 15 no of families are landless, 100 have land less than 1 ha, 200 families have land within 1-2 hectare and 80 farmers have land more than 2 hectare. The main crops grown in the area are cereals, groundnut, soyabean and wheat. But due to less rain this year very few have grown wheat. Of the total 700 acres of cultivable land 250 acres of land are used for growing wheat but only in 80-100 acres of land wheat has been grown this year. The wheat cultivation and harvesting practices are manual.

There are 800 no of cows, 40 no of buffalos, 150 no of bullocks and 500 no of goats and other animals in the village. There are only 2 no of tractors and 3 no of thresher in the village. The tractor is hired for Rs.250 per acre and thresher for Rs.100 per 1 bag of capacity of 80 kg. of wheat threshed. As per the farmers 30 quintal of straw is recovered when 100 kg of wheat is threshed out. There is no system of trading of the wheat straw in the village barring few inter village trade for fodder. The pattern of wheat straw use mainly rests on fodder which is around 80%. The rest 10% is used for compost preparation and another 10% is wasted.

➢ **Uttamsara:**

Uttamsara is located in the Bhatkuli taluka of Amravati district with a total geographical are of 16 sq. km. the total cultivated area of the village is 600 acre. This village houses 450 households. In the village around 100 families are landless, 50-60 have land 1 hectare, 150 have land between 1 ha. and 2 ha and 150 have lands in the range of 2-5 hectare.

The village has 500 no of cows, 100 no of bullocks, 25 buffalos and 500 goats and other animals. This year in 25 -30 acres of land wheat is grown with a production quantity of 11-13 quintal per acre. The village has 6 tractors, 6 threshers and 4 trailers. The tractor hiring charges per acre is Rs. 250. The thresher hiring charges is Rs. 100 per bag and trailer hiring charges is Rs. 90 per bag. 30 kg of wheat straw is recovered from 100 kg of wheat threshed. 80% of wheat straw recovered is used for fodder purposes and rest 20 % is used for compost preparation.

The wheat straw is not traded to any paper mill or any other industry. Only few farmers with more cattle buy the straw for fodder.

➢ **Takli Bujru:**

Takli Bujru is a village in Nandgaon Khandeshwar taluka of Amravati district. It has 750 households with 900 acres of land under cultivation. The village has 100 landless families, 300 families with upto 2.5 acre of land, 350 families with 2.5 to 5 acre land and 50 families with more than 5 acres of land. The

main crops cultivated in the village are soyabean, groundnut, cereals, cotton and wheat. This year in 50-80 acres of land wheat has been cultivated. And the productivity of wheat per acre is 8-12 quintals. The wheat variety cultivated is Lokwan, Narmada and Rani. Per quintal of wheat 35-40 kg of wheat straw is recovered. 1000 cows, 100 buffaloes, 500 bullocks and 800 goats are there in the village.

There are 4 tractors, 4 trailers and 8 threshers in the village. The tractor is hired for or Rs. 250 per acre. The thresher is hired for Rs.250 for one quintal of soyabean crushed and Rs.150 for one quintal of wheat crushed. 90% wheat straw is used for fodder purposes of the total straw recovered and the rest 10 % is either wasted or used for compost making.

- **Loni Takli:**

The village Loni Takli is in the Nandgaon Khandeshwar of Amravati district. It has a geographical area of 25 sq. km. The total cultivated area is 800 acres. The village has 600 families of which 300 are landless labourers, 90 have land within 1 ha, 100 have land within 1-2 ha and 50 have more than 2 ha of land.

In the village, the buffalo population is around 700 and the cow population is 500. 50 bullocks and 400 goats are also there in the village.

The cultivable area under this village is irrigation-deficit prone area. So wheat cultivation has reduced in the recent years here. Of the total 800 acre of land, 50-70 acres of land are under wheat cultivation where facility of well-water irrigation is there. Per acre production of wheat is 7-12 tonnes in this area and the wheat straw production is 3-4.5 tonnes per acre. The cultivation and harvesting practices are manual. However the village has 14 tractors, 15 threshers and 12 trailers. The tractor, thresher and the trailers are hired by the farmers of the village and farmers of other villages also. The per acre charges for hiring a tractor is Rs.250 and hiring the thresher the charges is Rs.120 per bag of wheat. sometimes 5 kg of wheat is charged in stead of money for one bag of wheat threshed.

50% wheat straw is used for fodder purposes, 30% for manure preparation and 20% is wasted. there is no system of selling of wheat straw in the market or to any industry units. However, small quantities of straw are traded within the village for fodder purposes. For one bullock cart of wheat straw which is around 1.8-2 quintal Rs.250 is charged.

- **Madurai District, Tamil Nadu**
  - **Velakundu:**

This village is situated in the Madurai North taluka of Madurai district. The village has 200 household. The total geographical area of the village is 500 acres. There are mostly landless farmers in the village with few farmers with larger landholdings. Around 5-6 farmers have more than 5 hectare of land, 15 have 2-5 hectare,30 have 1-2 hectare, 20 have less than 1 hectare land and 140 have no cultivable land. The major crop cultivated in the area is rice. The annual production of rice in the village is around 400 tonnes which gives around 300 tonnes of rice straw. The harvesting practices are manual. The

village has 10 tractors and 3 power trillers. Tractors are hired for Rs.950 for one acre and power trillers for Rs.750 per acre.

Per acre production of rice in this village varies from 16-18 quintals. The rice straw recovered is used mainly for fodder purposes with around 70% use. 20% straw is used for household purposes and rest 10% is either wasted or used for compost making. The rice straws are not sold to any factory or units.

- **Rajakur:**

Rajakkur is the village in Madurai North tehsil of Madurai district. The village has 350 households with total geographical area of 1020 acres of which 700 acres are used for cultivation. In the village only few farmers have larger landholdings with more than 5 ha that holds larger portion of the total cultivable land of the village. The total no of landless farmers is around 120 and that of less than one hectare is 50. While 20 have land holding between 1-2 hectare and another 20 have land holdings between 2-5 hectares.

The total area under rice cultivation is 500 acres with one time cropping and the total annual production of rice is 800 tonnes with rice straw production of 550 tonnes. The rice straw recovered is used mainly for fodder purposes with 75% use. Another major use of rice straw is in households with 15% use followed by the rest 10% which is wasted or burnt. No rice straw is used for selling purposes barring few quintals of intra village trade for fodder.

- **Mailan Gundu:**

This village is situated in Madurai North Tehsil of Madurai district. It has 120 acre of total geographical area with 80 acres used for cultivation purposes. This village is a small village with 80 no of families. Of the total 80 families 50 are landless, 15 have land less than 1 hectare, 10 have lands between 1-2 hectare and 5 have2-5 hectare land. only 2 families have lands more than 5 hectares.
The total rice straw cultivation from 130 tonnes of annual rice production is around 80 tonnes which is primarily used for fodder for animals. The village has 2 tractors and 1 small power triller. The tractor is hired out at Rs.1000 per one acre and the power triller for Rs.800 per one acre. There is no system of trading of rice straw.

- **Chinnailandaikulan:**

Chinnailandaikulan village is situated in Madurai North tehsil of Madurai district. The village has a total geographical area of 800 acres. It has 350 families with a cultivable land of 600 acres. Of the total 350 families, 100 families are landless, 80 have less than one ha land, 150 have land holding of 1-5 ha and the rest farmers have more than 2 ha land.

The village is rice cultivated area with total annual rice production of 700 tonnes with a straw production of 500 tonnes. The farmers use the rice straw for household and fodder purposes with more than 80% use. The rest 20% is wasted. no rice straw is sold to any industry.

❖ **Barnala District, Punjab**

➢ **Pakhokalan**

Pakhokalan is a village in Sangrur district. Abhishek Paper mill is the nearest paper mill at a distance of 9 km from the village. The village has a total geographical area of 9000 acres of which 8000 acres are cultivable land.

The village has around 2000 families of which 1000 families are landless. 400 families have land holding of less than 1 ha, 300 have less than 1 to 2 ha, 150 families have 2 to 5 ha and rest 150 ha have more than 5 ha land.

Buffalo population is more in comparison to cattle population. The village has approximately 300 cows and 500 buffalos whereas the bufflalo population is 6000.

The total rice production in the village is 7000 tonnes and wheat production is 5000 tonnes. The total rice straw production is 4200 tonnes @ 6 quintals per acre and the total wheat straw production is 9800 tonnes @14 quintals per acre of land.

There are 900 number of tractors, 30 threshers and 80 combine harvesters in the village. Rs.1500 per ha. or Rs. 600 per acre is charged for hiring a thresher or a combine harvester.

About 60% of the total wheat straw produced is sold to the paper mills, 30% is used for fodder and 10% is wasted. The wheat straw is procured by the traders for selling to the paper units. In 2008-09 the wheat straw selling price was Rs.1500-2000 per tonne, and in 2009-10 the selling price has gone upto Rs.3000 per tonne. The farmers are either wasting or burning the rice straws in the field. Small and marginal farmers are selling 40% of the total wheat straw to the paper mills and the rest 60% is sold by the middle and large farmers having land holding of above 2 hectares.
The farmers are paid by the traders through cheque. The constraints faced by the farmers are the traders are purchasing the wheat straw at a lesser price and after hoarding for few days they are selling to the paper mills.

➢ **Akliya:**

This village is located in Mansa tehsil of Mansa district at a distance of 14 km from the Abhishek paper mill. The village has a total area of 5000 acres with a total household of 1100. It has 3000 acres of cultivable land. The land holding pattern of the village reveals that around 500 families are landless and 200 families have less than one ha land. about 200 families have land within 1 to 2 ha and 150 have land holding within 2 to 5 ha. 50 families have land holding of more than 5 ha.

The cattle population in the village is less than the buffalo population. There are about 4200 buffalos and 500 bullocks in the village with a total cow population of 200.

The total wheat production in the village is 1.5 lakh gatta (1 gatta = 35 kg.) amounting to 5250 tonnes. and the rice production is 70,000 gatta (1 gatta = 50 kg) amounting to 3500 tonnes. There are about 500 tractors, 15 threshers and 50 combine harvesters in the village. Rs. 600 per acre or Rs. 1500 per ha is charged for hiring a thresher or a combine harvester.

The average per ha wheat straw production is 14 quintals in the village. Taking a total area of 3000 acre of wheat cultivating land, the total wheat straw production comes to 4200 tonnes. The total rice straw production in the village is 1800 tonnes @ 6 quintals per acre. Of the total wheat straw produced 50 % is used as fodder, 40% is sold to the paper mills and 10% is wasted. Rice straw is mainly burnt in the field itself or destroyed later on. Wheat straw is sold @ Rs.3000 per tonne. This is procured from the farmers through the traders.

The farmers sell the straw immediately after harvest and some farmers with storing facility sells after few months. Normally the wheat straw is negotiated in the field and sold to the traders.

- **Parwahi**

Parwahi village is situated in Barnala tehsil of Sangrur district. The village located at a distance of 25 kms from the Abhishek paper mill. The village has total 1150 households. The total geographical area of the village is 2300 acres with a total cultivable area of 2100 acres. Rice is cultivated in 1800 acres of land and wheat in 2000 acres of land in the village.

The village has about 300 landless farmers and 500 farmers with average land holding of 1 to 2 ha. 500 farmers have land holding of more than 5 ha. The village has 1500 buffalos and 200 cows.

The average production of rice in this village is 30 quintal per acre and that of wheat is 18 quintals per acre. The total annual production of rice in the village is 5400 tonne and that of wheat is 3600 tonne. The village has 100 tractors, 5 threshers and 4 combine harvesters. Rs.1200 per acre is charged for hiring a thresher and Rs.700 per acre is charged for hiring a combine harvester. About 15 quintal of wheat straw is recovered from an acre. The total wheat straw recovery comes to 3000 tonnes. Of the total wheat straw recovered from village, 30% is sold to the paper mill and the rest is used for either house hold purpose or for fodder purposes. The total rice straw recovered is destroyed in the field.

Traders collect the wheat straw from the farmers and sells to the paper mills. The wheat straw is purchased from the farmers at Rs.3000 per tonne. In 2008-09 the price of wheat straw was Rs.1500-1600 per tonne and in 2007-08 the price of wheat straw was Rs.1700-1800. The farmers with more than 2 ha. of land sell the wheat straw.

The main constraints faced by the farmers in selling the wheat straw is lack of storage facilities. If the straw is stalked for a longer time the less amounts is paid by the traders to the farmers.

- **Sekha:**

Sekha village is situated in Barnala tehsil of Sangrur district in Punjab. The village has 1400 number of households. The total geographical area of the village is 5000 acres of which 3000 acres are used for cultivation purposes.

50% of the farmers in the village are landless. Of the rest 50% farmers most have a land holding of 1-5 ha. The number of households with total land holding of 2-5 ha is 300, less than 1 ha is 200 and 1-2 ha is 250. The livestock population mainly consists of buffalos with 1000 numbers where as the cattle population is around 300.

The average rice production per acre is 28 quintals and that of wheat is 18 quintal per acre. Taking into account 3000 acres of rice and wheat cultivable area, the total rice production is 8400 tonne and total wheat production is 5400 tonnes.

The village harbours 600 tractors, 20 threshers, 6 combine harvesters and 20 reapers. The hiring charges for a thresher and a combine harvester is Rs1200 and Rs700 per acre. The hiring charges for a reaper is Rs.800 per acre.

The total wheat straw production in the village is 5000 tonnes with 40% of the straw being sold to the paper mills. The wheat straw price per tonne in 2009-10 was Rs.3000-3200, in 2008-09 was Rs.1500-1600 and in 2007-08 was Rs.2500-2600.

The farmers waste or burn the rice straw and use 60% of wheat straw for fodder and household purposes. The farmers revealed that around through combine harvester the wheat straw recovery is less than manual harvesting. The average wheat straw recovery is 18-20 quintal per acre in manual harvesting while in combine harvester the recovery of wheat straw is 10-12 quintal per acre.

- **Pilibhit:**
  - **Jahanbad**

This village is in the Pilibhit taluka of Pilibhit district. The village has a total geographical area of 891 ha. The cultivable area is 578 ha.

Wheat and sugarcane are mainly cultivated in this village. The village has total 330 families of which 175 are landless. Majority of farmers have a land holding of less than 2 ha. Total annual wheat, rice and sugarcane production in the village are 300 tonne, 800 tonne and 3900 tonnes respectively. The village has 110 tractors and 15 threshers. The thresher renting system in the village is for every quintal of wheat threshed 10 kg wheat is given out.

The farmers in the village sell wheat straw to the paper mills which are supplied to the paper mills in Muzaffarnagar area. The annual wheat straw production is 900 tonnes in the village. Wheat straw is used by the households for fodder purposes except small quanities are wasted or used for compost

making. Very few farmers with landholding of above 4 ha have surplus wheat straw which they sell to the paper mills at Rs.1900-2000 per tonne.

Due to fodder use and other domestic use, the surplus wheat straw are sold to the paper mills.

- **Devipura:**

The village Devipura is in the Pilibhit taluka of Pilibhit district. It has a geographical area of 245 ha. The total cultivated area is 186 ha. The village has 133 families of which 70 are landless labourers, 45 have land within 1 ha, 10 have land within 1-2 ha and have more than 2 ha of land.

In the village, the buffalo population is around 350 and the cow population is 200. The cultivable area under this village is under irrigation. So wheat cultivation is major crop along with sugarcane cultivation. Per acre production of wheat is 12-14 tonnes in this area and the wheat straw production is 7-8 tonnes per acre. The cultivation and harvesting practices are manual. However the village has 14 tractors, 15 threshers and 12 trailers. The tractor, thresher and the trailers are hired by the farmers of the village and farmers of other villages also. The per acre charges for hiring a tractor is Rs.250 and hiring the thresher the charges is Rs.120 per bag of wheat. Sometimes 5 kg of wheat is charged instead of money for one bag of wheat threshed.

30% wheat straw is used for fodder purposes, 10% for manure preparation, 10% is wasted but 50% straw is sold to the paper mills. Small quantities of straw are also traded within the village for fodder purposes. For one bullock cart of wheat straw which is around 1.8-2 quintal Rs.250 is charged.

- **Bilaspur:**

There are 270 households in this village where 40% landowners have less than 1 hector land, around 45% have 1 to 2 ha land and 10% have more than 2 hector land. The remaining are landless labourers. This village is rich in livestock population.

The village has around 200 hectare of cultivated area in which around 60% land is used for cultivation of wheat followed by sugarcane (40%). Rice is another major crop in the area. Per acre production of wheat is 10 quintal to 14 quintal.

The village has 59 tractors with 55 trailers. Also it has 6 threshers and 2 combine harvester. Rs 800 is charged for a tractor for one acre of land and Rs.800 is charged for trailer for one acre. For hiring one thresher Rs.100 is charged for threshing one bag of wheat with 100 kg. capacity. The combine harvester is hired for Rs.800 per acre.

Apart from other uses of wheat straw most farmers sell the straw to the paper mills in western part of Uttar Pradesh. Only paltry amount of wheat straw is traded for fodder purposes. Traders procure the wheat straw for paper industry or dairy farms @ Rs2000-Rs2500 per tonne.

- **Amaria:**

Amaria is a village in Pilibhit district. The village has a total geographical area of 9000 acres of which 8000 acres are cultivable land.

The village has around 1200 families of which 600 families are landless. 200 families have land holding of less than 1 ha, 300 have less than 1 to 2 ha, 50 families have 2 to 5 ha and rest 50 ha have more than 5 ha land.

Buffalo population is more in comparison to cattle population. The village has approximately 300 cows whereas the bufflalo population is 800.

The total rice production in the village is 7000 tonnes and wheat production is 5000 tonnes. The total rice straw production is 4200 tonnes @ 6 quintals per acre and the total wheat straw production is 9800 tonnes @14 quintals per acre of land.

There are 200 tractors, 20 threshers and 5 combine harvesters in the village. The hiring charges for a thresher or a combine harvester is Rs.1500 per ha. or Rs. 600 per acre.

About 60% of the total wheat straw produced is sold to the paper mills, 30% is used for fodder and 10% is wasted. The wheat straw is procured by the traders for selling to the paper units. The wheat straw selling price was Rs.1500-2000 per tonne. The farmers are either wasting or burning the rice straws in the field. Small and marginal farmers are selling 30% of the total wheat straw to the paper mills and the 40% is sold by the middle and large farmers having land holding of above 2 hectares.

- **Deoria District, Uttar Pradesh**

- **Asana:**

This village is situated in the Deoria taluka of Deoria district. The village has 200 households with 1000 population. The total geographical area of the village is 450 acres out of which 270 acres are irrigated. The land holding pattern is evenly distributed among the farmers. There are more number of landless farmers and fewer farmers have larger landholdings. Around 5-6 farmers have more than 3 hectare of land, 15 have 2-5 hectare,30 have 1-2 hectare, 20 have less than 1 hectare land and 70 have no cultivable land. The major crop cultivated in the area is rice, wheat and sugarcane. The annual production of rice in the village is around 400 tonnes which gives around 300 tonnes of rice straw. The harvesting practices are manual. The village has 10 tractors and 3 power trillers. Tractors are hired for Rs.950 for one acre and power trillers for Rs.750 per acre. Per acre production of rice in this village varies from 16-18 quintals. The wheat straw recovered is used mainly for fodder purposes with around 70% use. 20% straw is used for household purposes and rest 10% is either wasted or used for compost making. The wheat or rice straws are not sold to any factory or units.

- **Badhya:**

Badhya is the village in Deoria tehsil of Deoria district. The village has 250 households with total geographical area of 300 acres of which 200 acres are used for cultivation. In the village only few farmers have larger landholdings with more than 5 ha that holds larger portion of the total cultivable land of the village. The total no of landless farmers is around 120 and that of less than one hectare land holding is 50. While 20 have land holding between 1-2 hectare and another 20 have land holdings between 2-5 hectares.

The total area under wheat cultivation is 500 acres with one time cropping and the total annual production of wheat e is 800 tonnes with wheat straw production of 550 tonnes. The wheat straw recovered is used mainly for fodder purposes with 75% use. The major use of rice straw is in households with 15% use followed by the rest 10% which is wasted or burnt. Apart from intra village trade of rice straw or wheat straw no significant amount is sold for any industrial use.

- **Katai:**

This village is situated in Rudrapur Tehsil of Deoria district. It has 630 acre of total geographical area with 500 acres have irrigation facility which is mostly used for cultivation purposes. This village has 355 families with a total population of 2250. There are 210 landless farmers in the village. 50 farmers have land less than 1 hectare land, 20 have lands between 1-2 hectare and 25 have2-5 hectare land.

The total rice straw production is 830 tonnes and total wheat straw production 560 tonnes. Wheat straw is primarily used for fodder for animals. The village has 22 tractors and 7 small power trillers. The tractor is hired out at Rs.1000 per one acre and the power triller for Rs.800 per one acre. The rice straw or wheat straw are not traded in the village.

- **Dubauli:**

Dubauli village is situated in Rudrapur tehsil of Deoria district. The village has a total geographical area of 120 acres. It has 70 families with a cultivable land of 80 acres. Of the total 70 families, 40 families are landless, 15 have less than one ha land, 6 have land holding of 1-5 ha and the rest farmers have more than 2 ha land.

The village is wheat and rice cultivated area with total annual wheat production of 340 tonnes with a straw production of 260 tonnes. The wheat straw is mainly used for fodder purposes. The farmers also use the rice straw for household and fodder purposes with more than 60% use. The rest straw are wither wasted or burnt in households.

6.3 Survey of Paper Mills

In order to analyse the socio-economic impact of existing agro-residue based paper mills in identified clusters, a survey of operating paper mills in such clusters was conducted. The objective was to identify the improvement in quality of life which took place as these paper mills provided opportunity to villagers to sell their surplus agro-residues for a price, which otherwise would have been wasted.

The survey of paper mills was conducted in following clusters as already identified in the Inception Report.

- Muzaffarnagar in Western UP
- Ludhiana and Sangrur in Punjab
- West Godavari in Andhra Pradesh
- Ahmednagar in Maharashtra

In the Ahmednagar district of Maharashtra all the paper mills based on agro-residues were found to be closed for either non-availability of agro-residue at economical prices or because of pollution control norms. Of the previously identified cluster of agro based paper mills in Ludhiana, only one paper mill was found to be in operation. So another paper mill with bigger capacity from Sangrur district was included in the survey. In West Godavari and Muzzaffarnagar, however, four paper mills in each district were surveyed.

The responses of individual paper mills covered doing the field survey are briefly brought out in the succeeding paragraphs.

❖ **Rana Papers Ltd., Muzaffarnagar.**

Rana Papers Ltd. (RPL) was established in the year 1997 at 8 KM, Jansath Road, Muzaffarnagar (U.P.), about 120 KM from Delhi, to manufacture a wide range of kraft paper based on agro raw materials with an annual capacity of 16500 TPA which was subsequently increased to 35000 TPA. The present turnover of kraft paper is 50-60 TPD and that of kraft liner board 100-120 TPD. The mill mainly uses two types of agro residues as raw material for paper manufacture- bagasse and wheat straw with rice husk as fuel for the boiler of 8 MW cogeneration plant. Bagasse and wheat straw are used interchangeably depending upon the availability for the manufacture of kraft paper. Both bagasse and wheat straw are not used simultaneously.

For the manufacture of 1 tonne of agro residue 1.75 tonne of raw material is used where 40% is agro residue. The annual bagasse procurement is around 10,000 tonnes and wheat straw is around 9000 tonnes. Wheat straw is procured locally within a radius of 50 km. and sometimes in case of scarcity wheat straw is procured from some parts of Punjab and Uttar Pradesh. Bagasse is procured from the sugar mills in excess of their captive use. The bagasse is procured from SBEC sugar Ltd., Bajaj Hindustan Ltd. These residues are procured through traders only.

The price of bagasse ex-mill gate varies from Rs. 2000 to Rs. 2500 per tonne and that of wheat straw from Rs. 3000 to Rs. 3500 per tonne. As per the respondent 60 % of required raw material is procured within a radius of 50 km and rest 40% is procured within 50-80 km. The mode of transport of agro residues upto the mill gate is truck and tractor. Payment to the traders is made on cash basis and sometimes on 15-30 days credit.

The quantity per truck load of rice husk and wheat straw is 9-12 tonnes and of bagasse is 15 tonnes.

The constraints of procuring agro residues is mainly scarcity of raw material in immediate neighborhood which affects the overheads, transportation, handling and trader commission and thereby escalating the cost of raw material.

There are 15-20 paper mills in 50-80 km radius of this mill which compete for raw materials affecting the price and availability of agro residues in the area.

About 150 persons work directly in this paper mill. Besides many other household are benefited through employment in supporting transport and procurement of residues.

- **Bindal Duplex, Muzaffarnagar**

Bindal Duplex and Paper Boards manufactures two kinds of papers- agro based kraft paper and coated duplex board. The production of agro based kraft paper is 60 TPD and coated duplex board 40 TPD. The mill uses bagasse, wheat straw, sarkanda and elephant grass for manufacture of kraft paper and duplex boards.

For manufacture of kraft paper the mill is using bagasse, wheat straw, sarkanda and waste paper. 1 tonne of bagasse or 1 tonne of wheat straw is required for manufacture of 1 tonne of kraft paper and for 1.3 tonnes of waste paper is required for manufacture of 1 tonne of coated duplex board. The paper mill procures 18-20 thousand tonne of bagasse and 3-4 thousand tonne of wheat straw for paper and 6-8 thousand tonne of rice husk for boiler per annum. The agro residues are procured at the mill gate directly from the farmers. The farmers carry the residues either through tractor or trolley near to the farm gate where it is auctioned and sold to the paper mill. Some quantities of agro residues are procured through the traders from distant places. As per the respondent the raw materials are available mainly within 45 km radius and at times the rice husk is procured from a distance of 100-150 km.

The mills gate price per tonne of bagasse inclusive of transportation, loading and unloading charges is Rs. 1450-1500, of wheat straw Rs.2650-2750 and of rice husk Rs. 2150-2200. Around 70% of agro residues are procured within a radius of 50 km and the rest 30% beyond 50 km.

The farmers are paid normally on cash basis but sometimes the payment is made on credit of 5-7 days and in rare case up to one month. One time unloading charge is Rs. 50 per tonne and middleman/trader commission is normally 2-5% but these margins vary depending upon the availability of raw material and distance of procurement of raw material. The awareness level for commercial value of the agro residue is very high among the farmers.

Farmers are getting benefited directly by selling the agro residues to the paper mills. Secondly, people engaged in the transportation, loading, unloading are also being benefited. Further as the paper mill

procures bagasse from kollu (jaggery) units the families engaged in the kollu units are also being benefited.

In one kollu factory around 4 members from a family are engaged. In and around Muzzafernagar around 500 kollu units are there. So around 2000 members are being benefited though kollu units supplying bagasse to the paper units. For carrying 2500 tonne of kollu bagasse to the paper mills nearly 500 trolly tractor are used with a load of 5 tonne per tractor. 2500 families are benefited considering 5 people are engaged in transportation, loading, unloading activities in one tractor and one member from a family is engaged in this business.

Sarkanda is another raw material used in the paper mills. Sarkanda is available near the banks of river Ganga within 15-20 km radius of the paper mill. Nearly 1500 tonnes of sarkanda is purchased by the paper mills per day. With a truck load of 10 tonne, 150 trucks are engaged in carrying the sarkanda to the paper mills. 1 tonne of sarkanda is cut and bundled by a family of 5 members in a single day. So per truck of sarkanda 10 families are engaged and for loading and unloading of sarkanda 5-6 people are engaged. It means per truck of sarkanda, 55 people get benefited and in a single day 8250 people get benefited from the 150 trucks engaged in carrying sarkanda. The minimum daily earning per member for cutting and bundling sarkanda is Rs. 100.

As per the respondent all big mills have cogeneration facility. The total power requirement of the paper mills and sugar mills in Muzaffarnagar is around 200 MW. Out of which 80 MW requirement is met by cogeneration by paper mills with higher capacities. 75-80 MW is being supplied by the sugar units to the grid in excess of their captive power consumption and the rest is supplied by Uttar Pradesh Power Corporation Ltd.

The respondent has revealed the name of the paper mills in the area which affect the demand and supply of agro residues

(i) Parijat Paper Mill
(ii) Bindlas Paper Mill
(iii) Tehri Pulp & Paper
(iv) Bhageshwari Paper Mills
(v) Balaji Cellulose & Tissues Ltd.
(vi) Polymer Paper
(vii) Bindal Papers Ltd.
(viii) Sidhwali Paper Mills Pvt. Ltd.
(ix) Sakumbari Paper Mills
(x) Agarwal Duplex Mills Pvt. Ltd.
(xi) Meenu Paper Mills Pvt. Ltd.
(xii) Silvertone Papers Ltd.
(xiii) Garg Duplex Board Mills Pvt. Ltd.
(xiv) Silverton Pulp & Paper Ltd.

(xv) K.K. Duplex Mills Pvt. Ltd.
(xvi) New Shalimar Paper Mills Pvt. Ltd.
(xvii) Rana Papers Ltd.
(xviii) Mahalaxmi Papers Ltd.
(xix) Sidheshwari Paper Mills Pvt. Ltd.
(xx) Kirti Papers
(xxi) Shalimar Paper Mills Pvt. Ltd.
(xxii) Taj Papers
(xxiii) Suyash Paper
(xxiv) Aristo Papers
(xxv) Shamli Paper
(xxvi) Maruti Paper
(xxvii) Sikka Paper
(xxviii) Nikita Paper
(xxix) Galaxy Papers Pvt. Ltd.

❖ **Sikka Paper Mill, Muzaffarnagar**

Sikka Paper Mill manufactures three types of papers - writing and printing, MG poster and kraft paper with respective production capacities of 21000 TPA, 3000 TPA and 8000 TPA. The mill uses bagasse and wheat straw for paper manufacturing and rick husk for boiler of 2.5 MW cogeneration power plant. Bagasse is procured from November – March. The wheat straw is procured within a radius of 100-150 km. and rice husk from a distance of 80-150 km.

The total annual procurement of bagasse and wheat straw is 50,000 tonnes and rice husk is 30,000 tonnes. The agro residues are procured through traders only. The price of the bagasse varies greatly depending upon the availability. Price fluctuates between Rs 1500-2200 per tonne. The price of wheat straw and rice husk is close to Rs. 3000 per tonne. 30% of the agro residues are procured within a distance of 50 km. and the remaining 70% is procured from a distance of 100-200km. The agro residues are transported to the factory through trucks and tractors.

The payment to the suppliers of agro residues are made on cash basis as well as on credit. On credit basis maximum duration is 30 days.

The main constraint in procuring agro residues is scarcity of residues. Due to the presence of many paper units in the area acute shortage of raw material is faced which results in higher raw material cost. The mill provides direct employment to the factory labourers for 330 days per annum @ Rs. 150 per day for 8 hour shift.

❖ **Garg Duplex & Paper Mils (P) Ltd., Muzaffarnagar**

Garg Duplex & Paper Mills manufactures agro based kraft paper. It has an installed capacity of 15000 TPA and has a cogeneration plant of 5 MW. The mill uses wheat straw, bagasse and waste paper as raw

material for manufacture of kraft paper. It uses 1.3 tonnes of agro residue for the manufacture of 1 tonne of paper. The annual requirement of bagasse by the paper mill is 16000-17000 tonnes and of wheat straw 2000-3000 tonnes. The agro residues are procured through the traders at the mill gate. The price of bagasse at the mil gate ranges from Rs. 1500 to Rs. 1600 per tonne and of wheat straw from Rs. 2700 to Rs. 2800 per tonne. Rice husk price ranges from Rs. 2700 to Rs. 2800 per tonne. The 10% agro residue requirement is met from a procurement distance of 10km, 40% within a distance of 25 km, and 50% within a distance of 50-150km.

The main problem faced by the paper mill is low availability of agro residues near the paper mill resulting in higher overhead costs. The mill operates for 330 days in a year and generates employment of about 49500 mandays per annum.

- **Abhishek Industries Ltd., Barnala, Sangrur, Punjab**

Abhishek Industries the flagship company of the Trident Group, has one of the world's largest agro-based paper mill. This group is also in the business of towel manufacturing and yarn production. In the paper division employs around 200-300 administrative staff and 1100-1200 people in the factory.

Abhishek manufactures 10 types of paper in two plants- one plant with capacity of 125TPD and another with 300TPD with annual installed capacity of 1,75,000 tonnes. The cogeneration plant in Abhishek Industries is of 49.4 MW capacity.

The plant with 125 TPD capacity manufacturers cream wove, eco-print, ivory white, super white paper.

The plant with 300 TPD manufactures primeline SSML, crystalline SSML, silverline SSML, goldline SSML, my choice copier paper, spectra copier paper.

2.2 tonne of wheat straw with 4-5% of dust and 8-12% moisture content is required to make 1 tonne of pulp and 0.89 tonne of pulp is required to make 1 tonne of paper. It means 1.96 tonne of wheat straw is required to make 1 tonne of paper. The daily requirement of wheat straw is 430 -475 tonnes.

50 % wheat straw requirement of the plant is met within a distance of 50 km and rest 50 % within a distance of 125 km. Earlier within 75 km the residues was available in abundance but now due to mechanical harvesting and less crop production the wheat straw shortage has been felt and to meet the demand it is to be procured from a distance of 100-125 km.
Five years back the price of the wheat straw was Rs. 500 per tonne. The mill gate price of wheat straw now is Rs. 3600 /T if obtained from local area within 50 km. and if obtained from distant places the price is Rs.3900/T. The above prices are inclusive of cost of transportation @ Rs.200/T, for 50 km distance and of loading and unloading charges is Rs.150-200 each for 10 persons.

After the delivery of the residue at the mill, the sample is obtained in presence of the person in charge of the stock and is sent for laboratory for testing of dust and moisture. After the result of the sample is

obtained after 2-3 days, necessary corrections in payment is made on dry weight basis and payment is made to the traders through cheque immediately.

The paper mill holds camps in villages to sensitise villagers about the value of the agro residues and their uses. The firm make them understand about the usefulness of agro residues, their proper storage and harvesting practices to ensure better recovery. Due to mechanical harvesting much useful straw portion is left out in the field and some traders with the help of farmers are digging that out with the help of grabbers and supplying to the plants. As per the respondent, the dug out portion contains dust and silica which is deteriorating the machine of the paper plant.

Normally the traders contact the farmers before the season and make advance payment to them for the straw. The farmers use the advance money for repayment of loans. No farmers supply directly to the mill. Very few farmers with 40-50 acres land are contacted directly by the mill to supply the residues directly. The mills can not appoint agents to collect residues because of the traders' nexus with the political people and their influence. Also the mill cannot pay in advance to the individual farmers before the season and run after the defaulters for supply. The advantages of getting residues from traders are:

- Traders ensure regular supply.
- In case of urgency payment to the suppliers can be delayed.
- Residues can be supplied by the regular suppliers from distant places in case of shortage

The mill prefers to obtain the residues at a higher rate from the traders who can supply regularly and in larger quantity rather than from traders who can supply lesser quantities even if their price is lower. Subsidy to the power plants is given by the Ministry of New and Renewable Energy where as no such subsidy is given by the Ministry to the paper mills.

Small power plants (coal based) are using wheat straw in some quantities in their boiler due to shortage of rice husk in the area and higher price of the rice husk.

Around 50 % of the residue is used as fodder by farmers with more than 3 acres of land and sell the excess residue whereas small farmers keep the entire residues for fodder. The rice straw is burnt in the field as it is not used as fodder and is not procured by the industries.

The wage of contractual labourers working in the factory is Rs.5000 per month. Each farmer supplying the residue on commercial basis is benefited to the extent of Rs. 25,000 per acre. The company is running at loss because of higher raw material cost and reduction in price of paper in the market.

Talking about other paper mills in the area, the respondent indicated that Sethia Paper Mill which is 70-75 km away from the Abhishek paper is procuring around 35000 TPA of residues. Sethia Paper Mill is using 30000 TPA of sarkanda with 50% moisture where as ABC Paper Mill is using 1,50,000 TPA of sarkanda.

❖ **Shreyans Industries Ltd., Ludhiana**

The company has two paper manufacturing units located at Ahmedgarh (Distt. Sangrur) & at Banah (Distt. Nawanshaher). Over the years number of modernization-cum-expansion schemes have been undertaken and the present installed capacity of manufacturing writing & printing paper, from agro-based raw materials, is 37000 TPA.

The Company has also set up Chemical Recovery Plants at both the paper units. This has enabled economizing on consumption of chemicals and simultaneously achieving the prescribed standards of effluent discharge. There is a captive power co-generation plant with a capacity of about 5.6 MW at Ahmedgarh unit, and of 5 MW at Banah unit. With a view to improve the quality of pulp and save on cooking chemicals, Continuous Digesters have been installed in both the units. The units at Ahmedgarh & Banah have their own E.O. bleaching plants for manufacturing high bright, superior quality paper. The salient features of the discussions held with Shreyans Industries is given below:

1. In Shreyans Papers, 100-120 tonnes of writing and printing paper is manufactured daily.
2. Normally during the harvesting season the residues are available in abundance in a radius of 30-50 km . in case od good harvest in a season the residue requirement is met up to 70% in 30-50 km radius and rest from far away places. In years of normal harvests the requirement is met up to 40% from local areas and 60% from far away places.
3. In pulp making for writing and printing paper, 92% wheat straw and 8% other fillers such as soap stone and chemicals are used. Around 1.9 tonnes of dry wheat straw is needed to make 1 tonne of paper. The procured wheat straw contains 20-30% moisture. The daily requirement of the mill is 250 tonnes of wheat straw. This 250 tonnes of wheat straw after drying and dust removal becomes 185 tonnes of pulpable straw which forms 92% of total pulp.
4. Annually 10-15% of the total pulp requirement is met from bagasse if bagasse is cheaper than wheat straw. Considering the total annual requirement of 87500 tonnes , 8750-13125 tonnes of bagasse is used. The total wheat straw requirement is around 87500 tonnes (250 T * 350 days) with 20-30% moisture. Only 2-3% of total annual requirement is met by farmers from nearby places selling directly to the mills.
5. The source of procurement is always through traders to overcome the hassles of immediate payment, smaller quantity and to ensure regular supply. Also the trader takes charge of all overhead expenses like transport, loading, unloading and labour handling etc. 15-20% is the overhead and transportation cost of the total value of the load.
6. Normally the trading system is highly disorganisized in the wheat straw procurement segment.
7. The delivered price at the mill gate is Rs. 3300 per tonne of wheat straw which includes transport cost, labour charges and loading and unloading charges. The middleman commission is 7-10% of the price of the load.
8. Transport cost includes diesel charges and other expenses including octroi and fooding charges etc. which depend upon the distance of procurement.
9. Loading and unloading charge is Rs. 200 per person. In loading 10-12 labourers are engaged and in unloading 2-3 labourers are engaged per tractor.

10. All payments are made by cash.
11. The normal transported quantity is 8-9 tonnes in a tractor if the materials are procured with in a distance of 50-60 km radius. Otherwise the load is 12-14 tonnes. In case of transportation from 100-150 km the price of the residue is determined after evaluating the availability of the straw, the future scenario and arrival of wheat straw. But this keeps on changing every week. In 2009-10 the price ruled in the range of Rs. 3500-3800 per tonne where as 2008-09 it was Rs 2000-2500 per tonne.
12. There are 475 labourers working in the Shreyans Industries. The employment generated is 166250 man days per annum. (350 days* 475 men) @ of Rs. 210 per man-day.
13. The problem faced by the mills are:
    - During short supply seasons raw material prices rule very high.
    - Due to use of harvesting machine 15-20% less residue recovery is taking place. In manual harvesting 30-35 quintal/acre residue is recovered but in mechanical harvesting 15-20 quintal/acre is recovered.
    - Mushroom units in Lalur (Agro Dutch Pvt. Ltd. in Patiala) are using 60-70 tonnes of wheat straw per day.
    - Low availability of bagasse also shifts the demand to wheat straw because of the use of bagasse in cogeneration in sugar mills as well as paper units. Also increase in capacity of paper plants calls for higher requirement of raw material which leads to shortage of raw material and hence higher cost.
14. Other units using agro residues in the area are Abhishek Industries, ABC Paper Mills, SN Paper Mills, Balbinder Paper Mill, Shri Rishabh Papers, Amrit Papers, Hind Papers, Sethia Papers and Roshan Papers.

❖ **The Pravara Pulp & Paper Mills Ltd.**

Pravara, Ahemadnagar (A division of Padmashri Dr. Vitthalrao Vikhe Patil Sah. Sakhar Karkhana Ltd.)

The unit was shut down 6 years ago. The mill had capacity of 25 TPD. The mill manufactured printing paper with 80% bagasse & 20% wheat straw as raw material. The unit closed down due to its inability to meet the pollution control board norms. Also the cost of production of paper was higher than its market price and no subsidy was given to the paper mills which resulted in losses and ultimately in shutting down. The import policy of the govt. also disabled the co-operative paper units to match with the competition. Particularly the soft policy of the govt to import waste paper no initiative was taken to support the agro based paper units. These factors lead to closing down of all the paper mills in Ahemadnagar area. Presently the unit is operating only sugar factory.

The installed capacity of the sugar unit is 4,000 TCD & the daily cane crushed is 5,000 TCD. Annually the mill operates for an average of 180-230 days. Presently the company has no excess bagasse. The bagasse generated is being used in the boiler of the distillery. The sugar unit is planning to establish a cogeneration facility of 40 mw to supply electricity to the grid.

❖ **Rajhans Paper Mills**

Amrut Nagar, Ahemadnagar (A division of Sangamer Bhag Shahakari Sakar Karkhana Ltd.)

The paper mill is not in operation for the last 6 years. The capacity of the paper mill was 30 TPD. Printing paper was manufactured in the mill and bagasse was used as the major raw material with very little quantity of wheat straw. There was no shortage of raw material as Wheat straw & bagasse was easily available. The paper unit had run for 17 years. The cause of shutting down was levying of excise duty and no subsidy. The cost of production was going up without matching increase in market prices, resulting in financial losses. Around 400 employees lost their job due to closure of the paper mill.

Presently the company has captive co-generation. There are two boilers with capacity of 60 tonne per hour & 100 tonne per hour. Presently the plant runs for 190-230 days in a year. In the sugar mill 26-27% bagasse is generated from the total amount of cane crushed.

❖ **Rahuri Pulp and Paper Mills Ltd., Rahuri, Ahemadnagar**

The paper mill was a division of Baburao Bapuji Tanpura SSK Ltd. The mill is closed since the last 5 years.

❖ **Delta Paper Mill Ltd., Vendra, West Godavari**

Delta Paper Mills was established in 1975 and is situated at Vendra Village, West Godavari Dist., Andhra Pradesh. The Company manufactures Writing and Printing Papers of different cultural varieties such as Creamwove, White Printing, Azurewove, Azurelaid, Duplicating etc.

The Company uses unconventional raw materials like Paddy Straw and Bagasse. The company has daily production capacity of 150 TPD. It has got full-fledged Effluent Treatment Plant.

For Further development of the quality of paper, full utilization of capacity and for pollution abatement, the Company has embarked on Mill Development Programme under which the Pulp Mill has been upgraded for pulping bagasse by installing Continuous Digester System. Straw pulp can not be used as the waste liquor from paddy straw pulping can not recover the chemical, as well as the fuel value and hence the Company has switched over to Bagasse pulping. This has increased the requirement of Bagasse substantially with a simultaneous drastic reduction in paddy straw usage. Though all effort that are required for procuring Bagasse from other Sugar Mills are made its availability has become difficult in view of fact that most of the Sugar Mills are using their Bagasse for their Captive Power Generation. The Management has procured Sugar Mills, when the AP Govt. started disinvesting in Co-Operative Sugar Mills. Delta Sugars Ltd is one such Mill. The Management has also installed coal fired boiler in Delta Sugars Limited, Hanuman Junction, so that Bagasse can be released for use as raw material for the Paper Mills. Thus, the Company is procuring almost 50-65% of its bagasse requirement from its sister concern, M/s Delta Sugars Limited, Hanuman Junction, besides the procurement of Bagasse from other Sugar Mills in and around West Godavari District. The mill meets

50 % of its total annual bagasse requirement within a distance of 25 km and the rest 50 % within a radius of 50k.m.

The Company has also installed a 12 MW cogeneration Power Plant. In entire South India out of Agro-Based Paper Mills, the Company is the only mill having installed Chemical Recovery Plant for abating the pollution in the area.

For production of 150 tonnes of printing paper the mill requires daily 500 tonnes of bagasse with 50% moisture which forms 65% of total pulp requirement. The rest 35% is filled with waste paper pulp and lime stone. The daily requirement of lime stone powder for production of 150 tonnes of paper is 15 tonnes. The dry pulp to water ratio is 1:3.5.

Out of the total bagasse requirement around 65% bagasse requirement is met from its own sugar factory and another factory named KCP Sugar Mills. It also gets bagasse from other 2-3 small sugar mills. The mill procures its required bagasse within 40 km radius. The mill gate price of bagasse is Rs. 1,800 – 2,200 per tonne. The cost of transportation for truck is Rs. 500 per tonne including baling & loading.

Due to shortage of cane production in the current year, bagasse shortage is expected which would result in higher price of the bagasse.

The mill operates for an average of 330 days per annum and total 750 employees are working in the plant of which 515 are labourers. The cost of one labour per day at the factory is Rs.120.

- **Aruna Paper Boards Mills Ltd., Surya Raoplem, West Godavari**

This mill is situated near Tanuku in West Godavari district in Andhra Pradesh. It manufacture- Straw board and Writing & Printing paper. For straw board the mill uses rice straw and for writing & printing it uses waste paper. The daily production capacity of straw board is 15 tonnes and writing & printing 50 tonnes. The daily requirement of paddy straw for manufacture of 15 tonnes of straw board is 25 tonnes with an annual requirement of 8000 tonnes considering 26 working days a month. The mill procures the required rice straw within a radius of 50 k.m. Within this radius the availability of residue is ample. Sometimes there happens to be little shortage of residues whenever there is less rice production.

In this area rice is grown twice a year-in rainy season & in summer season. The first crop grown in rainy season has good quality straw than second crop but the surplus availability is less as people use it for fodder purposes with the belief that the good quality straw increases the lactation in cows. So the straw price is comparatively more after the first cropping season. The second crop which is grown in summer season has low quality straw and also available in less quantity due to lesser cultivation. From the last few years the govt. is not allowing to let the Godavari river water used for cultivation of rice in summer season.

Manual cultivation and harvesting is in practice in this area. From the last one year slowly mechanical harvesting practice is taking place with the increasing use of bailer & trailer. So the residue collection is expected to be more in future.

The mill procures 80% of its required straw from a distance of 25 km after first harvesting season but after second cropping season it procures 50 % of their requirement from the 25 kms and rest from next 25 kms . The mill gate price for the rice straw varies from Rs. 600-800 depending upon availability. Supply of paddy straw is made mainly through tractor and sometimes through bullock cart. There are collection persons appointed by the mill within 30 k.m for maximising collection. The mill procures straw from middle men to ensure regular supply from distant places and supply in case of shortage of straw. The cost of transportation, loading and other expenses are born by the supplier. Only the unloading inside mill premise is handled by 6 labourers appointed by the mill. For unloading from a tractor 2 labourers are required. Total 7-8 middle men supply straw to the mill through out the year. There are 350 people working in the mill of which 50 are administrative staff and 300 are labourers. The per day wages of labourers is Rs. 140.

- **Coastal Agro Industries, Tanuku, West Godavari**

Coastal Agro Industries Ltd. Is situated in Tanuku taluka of west Godavari dist. The mill manufactures two kind of papers- straw board and kraft paper. For manufacture of straw board it uses rice straw and for kraft paper it uses waste paper. It has installed capacity of 50 TPD both for straw board and for kraft paper. The mill requires around 100 tonnes of rice straw per day for manufacture of 50 tonnes of straw board and 60 tonnes of waste paper for 50 tonnes of kraft paper.

The mill procures the raw materials from a distance of 50-60 km through it s agents and pays Rs.800-Rs 1000 per tonne of rice straw at the mill gate. it has 20-25 agents to collect the raw material. The unloading is handled by the mill at its premises. 50 % of the total annual requirement of rice straw is met within a distance of 25 km. and the rest 50% are met within a distance of next 25-35km. The straw is carried to the mill through tractor and lorry. 70% of the supply is made thorough tractor and 30% through lorry.

The mill operates for around 300 days. It has 425 people working in the mill of which 350 are labourers. The daily wages for the labourers is Rs.100. The problem faced by the paper mill is shortage of quality labourers. No excise exemption is given by the govt. The taxation rate for straw board is same as for writing and printing where as it should be different as straw board manufacturing is very labour intensive. Around 150 labourers are engaged for manufacture of 25 tonne of straw board where as 50 people are engaged for manufacture of 25 tonne of kraft paper. There is a shortage of skilled labour in the area.

❖ **Jayanti Boards Ltd., Mandapara, West Godavari**

Jayanti Board Mills is situated in the outskirts of Tanuku town. The mill manufactures straw borad having an installed capacity of 30 TPD. It procures the raw materials from a distance of 35-40 k.m. The mill uses 50 tonnes of rice straw for manufacture of 30 tonnes of straw board. It procures the raw material through agents appointed by it to ensure regular supply to the mill. In the on season the mill procures the raw materials with in a distance of 20 km. while in the off season the procurement distance extends upto 50 k.m.

The supplies of the rice straw are made through tractor only. The mill pays Rs. 500-800 per tonne of unbaled rice straw. The mill has 150 staffs working in the mill of which 125 are labourers. A labourer is paid Rs. 120 per day by the mill. The mill operates for 300 days annually.

The salient features of the survey findings have been presented in the following delineation.

6.4 Structural Profile of Respondents

The paper units contacted had wide variety of product-mix namely creamwove, maplitho, copier, bond, kraft, writing and printing, straw board, MG poster, liner and duplex boards. The structural profile of respondents to the survey is presented in Table 6.01.

Table 6.01

Structural Profile of Respondents

Sl. No.	Type of Paper Manufactured	% of Respondents
1.	Creamwove / Maplitho	10
2.	Copier / Bond	10
3.	Kraft Paper	50
4.	Writing & Printing	40
5.	Straw Board	30
6.	MG Poster	10
7.	Liner	10
8.	Coated Duplex	10

Table 6.02 shows the product mix and production status of various respondents. It would be seen from the Table that about half of the respondents are manufacturing kraft paper.

Table-6.02

Production Mapping of Respondents

Respondents (%)

Sl. No.	Production (TPD)	Creamwove / Maplitho	Copier/ Bond	Kraft Paper	Writing & Printing	Straw Board	MG Poster	Liner	Coated Duplex
1	Upto 50			20	10	30	10		10

2	50-100			30	10				
3	100-150	10			20			10	
4	150-200								
5	200-300		10						
	Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The next in line is writing and printing paper being produced by 40% of the respondents whereas 30% of the respondents manufacture straw board.

The most popular production range of kraft, writing and printing and straw boards based on agro-residues has been found to be upto 100 TPD. More than 60% of kraft paper manufacturers had production of upto 100 TPD. About 10% indicated their production of copier/ bond paper ranging between 200-300 TPD, 20% respondents reported production of 100-150 TPD of writing and printing paper.

6.5 Type of Agro-residues for Paper Making

The most popular residue is wheat straw being used for all major varieties of papers (See Table 6.03. Straw board manufacturers are mostly using rice straw while bagasse is being used for making kraft paper, writing and printing paper and MG poster.

Table-6.03

Type of Raw Material Used by Type of Paper Manufactured

Respondents (%)

Sl. No.	Type of Paper	Bagasse	Wheat Straw	Rice Straw
1.	Creamwove/ Maplitho		10	
2.	Copier / Bond		10	
3.	Kraft Paper	40	40	
4.	Writing & Printing	20	20	
5.	Straw Board			30
6.	MG Poster	10	10	
	Total	**100**	**100**	**100**

6.6 Agro-Residue Availability Status

It was reported by 80% of the baggase based plants during the survey that baggase is available within 20-50 km radius. Only 20% said that it has to be brought from a distance of 50-100 km. In the case of wheat straw for 66% of respondents, radial-distance varied from 50-100 km whereas for rice straw users it was available within 20-50 km. (See Table 6.04.)

Table-6.04

Availability of Major Share of Agro-residues by Radial Distance

Respondents (%)

Sl. No.	Type of Residues	20-50 km	50-100 km	100-150 km
1.	Bagasse	80	20	
2.	Wheat Straw	20	80	10
3.	Rice Straw	100		
Total		**100**	**100**	**100**

It would be seen from Table 4 that agro-residues used by paper units are bagasse, wheat straw and rice straw. Other residues like sarkanda or grasses are not popular.

6.7 Norm of Consumption

In order to find out the amount of agro residue required per tonne of paper, respondents were asked to indicate consumption of agro residues in per tonne of paper manufactured in their plants. The average consumption was found to be as indicated in Table 6.05.

Table 6.05

Norm of Consumption of Agro-residue

Sl no.	Type of Residue	Residue Used Per Tonne Of Paper (in Tonnes)
1.	Bagasse for writing and printing paper	1.75-1.90
2.	Wheat straw for Creamwove/Maplitho/ Copier/ Bond	1.80-2.00
3.	Wheat straw for Kraft paper	1.30-1.75
4.	Wheat Straw for Writing and Printing	1.75-1.90
5.	Wheat straw for MG Poster	1.90-2.00
6.	Rice straw for Straw Board	1.60-2.00

6.8 Consumption Pattern of Agro-residue

About 60% of the respondents revealed that the bagasse quantity procured by them ranges between 10,000 and 50,000 tonnes per annum whereas the rest had an off take of upto 10,000 tonnes per annum. Very few respondents had requirement of over 1,00,000 tonnes bagasse per annum. In case of wheat straw the major consumption has been found to be below 10,000 tonnes per annum. There were however few respondents who were procuring wheat straw in quantities ranging between 50,000 and 2,00,000 tonnes per annum. In the case of rice straw, 33% of the respondents revealed that they were buying less than 10,000 tonnes of rice straw per annum and the rest were procuring quantities above 10,000 tonnes per annum.

6.9 Procurement Process

The procurement of bagasse is done directly from the sugar mill. This stands to reason as there is a concentrated source of bagasse and one does not have to collect it from different sources. Nonetheless, in Muzaffarnagar, one respondent indicated to be procuring bagasse from Jaggery units but in meagre quantities. However in the case of wheat straw all paper mills buy it from the traders whereas rice straw is procured through agents. Traders are involved only when the supply is from distant places. The difference between a trader and an agent is that the paper mill has no control over the traders whereas the agents are appointed by the paper mills themselves to procure rice straw from various sources and bring it to the mill.

Paper mills prefer to procure wheat straw through traders for reasons of regular supply and also because it is difficult for the paper mill to arrange supply from long distances. For procuring rice straw, mill are more comfortable with their agents to ensure timely supply and have control on prices. However, in case of supply from distanat places the traders are contacted for supply of rice straw.

6.10 Price Structure

The price of wheat straw at mill gate varies from Rs.2700 to Rs.4400 depending on the availability and the distance from which the wheat straw is procured. The middleman commission varies from 5-10% and over head and transportation cost constitutes 15-20% of the price. Loading and unloading cost normally varies from Rs.100-200 per person with 10-12 persons getting engaged for loading and 2-3 persons in unloading.

As compared to wheat straw, the prices of rice straw is much lower varying from Rs.500-Rs1000 per tonne. This is the mill gate price which includes transportation and loading charges. The ex farm price is still lower at Rs.350-700 per tonne depending on quality, availability and distance of source of supply. The transportation distance is maximum up to 50 k.m. Loading or unloading charge is Rs.100 per person with 5-6 persons getting engaged in loading and 2-3 persons for unloading. Generally the unloading activity is undertaken by the paper mill inside its mill premise at mill's own expense.

The mill gate price of bagasse is in the range of Rs.1450-Rs.2000 per tonne. During the survery it was found that at times, at least in case of one mill, the price is has gone as high as Rs.2500 per tonne. On the other hand in case of a paper mill in West Godavari bagasse was available at a price range of Rs.1800- 2200 despite it being the only paper mill using bagasse as raw material for production of paper.

As indicated earlier paper mills are procuring agro residues from distances varying from 5- 200 kms. Only about 10% of paper mills got their partial supply of agro residues (10-25%) from a radial distance of 10 kms. A radial zone of 25 km. however covered about 50% of the respondents who managed to get their partial supplies (25-50%). About 70% of the respondents were able to procure their 25-50% requirement of agro residues from a radial distance of 50 kms. Only about 20% of the respondents could manage 50-75% of the requirement within a radius of 50 kms. 30 % of the respondents had to go

to a distance zone of 100 kms for procuring 25-50% of their requirement. Very few of the paper mill go to more than 100 k.m for securing their partial supplies of agro residues.

6.11 Mode of Transportation

The most popular mode of transporting agro residues is tractor. Almost all paper mills use tractors as one of the mode of transportation. Truck is being used by about half of the respondents. Trucks are basically used for transporting bagasse. Bullock cart is employed by only 20% of the respondents for transportation of agro residues. This mostly includes rice straw. Wheat and rice straw is not transported by truck as the sagging load catches fire from the silencer pipe fumes. It does not happen in case of tractor as the exhaust pipe of tractor is in the front end at a distance from the trolley of the tractor.

In the case of truck (60%) the quantity per load varies from 10-15 tonnes while in case of tractor (70%) it is mostly 5-10 tonnes. About 30% of the respondents reported that they load their tractors to an extent of 10-15 tonnes also. Bullock carts however carries agro residues up to 5 tonnes only. As indicated earlier trucks are used to transport bagasse where the distance travelled is 50 kms. Tractors however deliver materials at all distances including 100-150 kms and in some cases up to 200 kms also.

6.12 Terms of Payment

The terms of payment for supply of agro residues include cash on delivery, on credit and partial advance payment. The majority of mills (70%) use cash on delivery as terms of payment. However, 100% cash payment is not made immediately. Some of the amount remains unpaid which is to be paid later with staggered payment schedule. The survey revealed that about half of the mills are taking agro residues on credit. About 20% of them avail a credit of 2-7 days and 10% for 8-14 days. The remaining respondents could get agro residues on credit of as high as 22-30 days. This 50% also includes those respondents who give partial payment at the time of delivery. Advance payment system is not very popular in this trade as only 10% of the respondents are using this system of payment. However whenever the advance payment is given it can be as high as 50%.

6.13 Employment Generation

Large number of people get employment in procurement, trading, transportation, over all supervision of supply chain management due to the presence of paper in the mill area. The number of man-days generated in the survey area has been as indicated in Table 6.06.

Table 6.06

Employment Generated by Survey Mills

Sl. No.	Man Days	% of Respondents
1.	<50,000	10
2.	50,000-1,00,000	30

3.	1,00,000-1,50,000	20
4.	1,50,000-2,00,000	30
5.	Above 2,00,000	10

It can be seen from the above table that majority of the respondents feel that this activity has been able to generate about 1,00,000- 2,00,000 man-days per annum per mill. The wages per man day varies between Rs.100 and Rs. 150 as indicated by 70% of the respondents. On this basis average service turnover from this activity calculates to about 200 lakhs per annum per mill.

CHAPTER SEVEN
SOCIO- ECONOMIC RELEVANCE ANALYSIS

7.1 General

Till the advent of commercial utilization of agro residues the farm incomes were confined to accrue from crops alone. The residues were either used homestead or composted or even burnt. India is endowed with substantial amount of agro residues majority of which are still not being utilized for productive purposes. The residues are either being burnt in-situ or utilized for less productive purposes. As per estimates, only about 15% of the residues fetch cash income to the farmers. Composting, thatching, and use as fuel in the rural households are the most dominant usage patterns of agro residues. Some of the residues are also being used as fodder for the cattle. Despite all these uses a substantial quantity of the residues are left unutilized eroding the farmers' income. The major residues capable of yielding fibre for paper making are wheat straw, rice straw, bagasse, jute/kenaf/mesta stalks and grasses such as *Cymbopogan citratus, Eulaliopsis binatam Heteropogon controtus, Sacharum munja, Sacharum procerum, Themeda arundinacea, Tripaseum laxum, Vetiveria zizinoides* etc.

The use of agro residues in paper making came as blessing to the farmers. By realizing the commercial value against this agro waste, the farmers' income improved through which they started addressing their livelihood security and also improvement in standard of living. The agro residues utilized by paper mills today are strongly linked with the social developments. This chapter attempts to find out the extent to which the use of agro residues in paper making is helping farmers through increased income.

7.2 Classificatory Profile of the Stakeholders

In order to assess the relevance of agro residues with social developments, multiple stakeholders have been contacted to solicit their opinion and gather parametric and non parametric view points. The respondents contacted were dominated by the primary stakeholders i.e the farmers themselves in two types of the areas i.e in paper mill clusters and clusters without paper mills. The obtained classificatory profiles of the farmers are discussed in succeeding paragraphs.

The relevance of the Industry to farm economy was studied at the farm household level and also at secondary level i.e. at trading & transport stages. At the house-hold level a random sample of 100 farm households was canvassed in each district while at the secondary level 10 traders and 5 transporters were interviewed in each district.

7.2.1 Social Composition of Household Surveyed

The households typically constituted of joint families. The socially disadvantaged segment constituted 50% of the total number of households (vide Table 7.01).

Table 7.01

Social Composition of Household Surveyed

% of Household

State	District	Family Type		Social Classification			
		Nuclear	Joint	SC	ST	OBC	Others
Maharashtra	**Ahemadnagar**	14	86	9	27	8	56
	Amravati	10	90	5	32	19	44
Uttar Pradesh	**Deoria**	40	60	0	23	0	77
	Muzaffarnagar	22	78	12	63	0	25
	Pilibhit	38	62	16	02	24	58
Tamil Nadu	**Madurai**	21	79	4	48	27	21
Punjab	**Barnala & Sangrur**	9	91	4	2	0	94
Bihar	**Sitamarhi**	11	89	1	71	0	28
Andhra Pradesh	**West Godavari**	24	76	12	23	6	59
	Average	**21**	**79**	**7**	**32**	**9**	**51**

7.2.2 Economic Composition of Respondents

The economic status of the sample was reflected by the pattern of operational holding size which revealed that 82% were small/ marginal farmers (vide Table 7.02).

Table 7.02

Sample Households by Operational Holding Size

(% of HHs)

State	District	< 1 ha	1 to 2 ha	2 to 5 ha	>5 ha
Maharashtra	**Ahemadnagar**	70	25	4	2
	Amravati	83	15	0	2
Uttar Pradesh	**Deoria**	77	4	0	19
	Muzaffarnagar	43	26	23	8
	Pilibhit	67	17	15	1
Tamil Nadu	**Madurai**	58	27	15	0
Punjab	**Barnala & Sangrur**	21	8	71	0
Bihar	**Sitamarhi**	95	5	0	0
Andhra Pradesh	**West Godavari**	70	24	7	0
	Average	**65**	**17**	**15**	**4**

7.2.3 Farm Employment by Family Members

On an average 2 male members and 1.4 female members per family worked on-farm and 1.3 male and 1.1 female members per household supplemented the family income from off farm vocations mostly during lean farm activity seasons (vide Table 7.03)

Table-7.03

Average working members per household **Nos.**

State	District	On - Farm		Off – Farm	
		Male	Female	Male	Female
Maharshtra	**Ahemadnagar**	2.4	1.6	1.1	1.0
	Amravati	2.3	1.4	1.1	1.0
Uttar Pradesh	**Deoria**	1.6	1.0	1.2	1.0
	Muzaffarnagar	2.5	1.9	1.5	1.0
	Pilibhit	2.1	1.1	1.3	1.0
Tamilnadu	**Madurai**	1.9	1.3	1.4	1.0
Punjab	**Barnala & Sangrur**	2.0	1.1	1.0	1.0
Bihar	**Sitamarhi**	1.7	1.1	1.1	1.2
Andhra Pradesh	**West Godavari**	1.6	1.2	1.5	1.0
	Average	**2.0**	**1.3**	**1.2**	**1.0**

7.2.4 Farm Income Composition

Fifty six percent households had an annual farm income of below Rs. 30,000 per annum i.e. Rs. 82 per day (vide Table 7.04).

Table 7.04

Annual Farm Income of sample households **(% Sample HHs)**

State	District	Below Rs 15,000	Rs 15,000 to 30,000	Rs 30,000 to 50,000	Above Rs 50,000
Maharashtra	**Ahemadnagar**	3	54	37	6
	Amravati	0	25	58	17
Uttar Pradesh	**Deoria**	53	42	3	2
	Muzaffarnagar	14	48	15	22
	Pilibhit	23	49	10	
Tamil Nadu	**Madurai**	15	44	27	14
Punjab	**Barnala & Sangrur**	3	10	17	70
Bihar	**Sitamarhi**	66	32	1	1
Andhra Pradesh	**West Godavari**	9	30	11	50
	Average	**21**	**37**	**20**	**22**

Off-farm income of sample households was of marginal nature being below Rs. 5000 per annum in case of 91% households.

7.2.5 Sample Composition by Off Farm Income

About 76% household derived less than Rs. 1000 per annum. (Vide Table 7.05)

Table 7.05

Off - farm Income of sample households **(% Sample HHs)**

State	District	Below Rs 1,000	Rs 1,000 to 3,000	Rs 3,000 to 5,000	Rs 5,000 to 10,000	Above Rs 10,000
Maharashtra	**Ahemadnagar**	84	12	3	1	0
	Amravati	86	4	3	6	1
Uttar Pradesh	**Deoria**	82	12	2	4	0
	Muzaffarnagar	68	7	7	2	15
	Pilibhit	81	7	4	5	3
Tamil Nadu	**Madurai**	70	3	4	7	16
Punjab	**Barnala & Sangrur**	94	0	0	1	5
Bihar	**Sitamarhi**	77	19	4	0	0
Andhra Pradesh	**West Godavari**	46	30	5	7	12
	Average	**76**	**10**	**4**	**4**	**6**

7.2.6 Households by Livestock Ownership

Livestock ownership pattern revealed that milking cows were preferred in Maharashtra and Tamilnadu Districts and buffaloes in U.P & Punjab for milk. Another typical feature of respondents was that other categories of animals comprising horses, mules, donkeys etc. were owned by more them 40 percent households. Poultry was owned by only 10% households in Maharashtra and Tamilnadu (vide Table 7.06).

Table 7.06

Livestock Ownership Pattern **(% HHs)**

State	District	Milch cow more than 2	Buffaloes	Poultry	Bullock	Other Animal
Maharashtra	**Ahemadnagar**	76	1	24	59	49
	Amravati	73	5	10	54	42
Uttar Pradesh	**Deoria**	18	24	3	23	12
	Muzaffarnagar	23	50	3	41	37
	Pilibhit	27	3	22	32	16
Tamil Nadu	**Madurai**	82	3	17	69	54
Punjab	**Barnala & Sangrur**	12	63	2	28	5
Bihar	**Sitamarhi**	3	28	5	5	20
Andhra Pradesh	**West Godavari**	29	8	13	34	23
	Average	**38**	**21**	**11**	**38**	**29**

7.2.7 Households with Agri Equipments

The poor economic status of the farm households also gets reflected in ownership of tractors by 18% sample, tractor driven equipment by 12% and irrigation pump sets by 30% except in Punjab where 64% households had tractors and 60% irrigation pump sets followed by Muzaffarnagar in UP where 38% has tractors and 35% irrigation pump sets (vide Table 7.07).

Table 7.07

Farm Equipment ownership of sample households (% HHs)

State	District	Tractor	Tractor Driven Equipment	Irrigation pump set
Maharashtra	**Ahemadnagar**	4	1	3
	Amravati	3	1	5
Uttar Pradesh	**Deoria**	11	4	52
	Muzaffarnagar	38	21	35
	Pilibhit	22	13	28
Tamil Nadu	**Madurai**	5	14	8
Punjab	**Barnala & Sangrur**	64	52	60
Bihar	**Sitamarhi**	14	3	49
Andhra Pradesh	**West Godavari**	9	2	2
	Average	**19**	**12**	**27**

The classificatory profiles discussed above reveal that the sampling exercise was almost error free and hence the opinion gathered will represent the universal population with in given area.

7.3 Zonal Availability of Agro Residues

The findings revealed that there is a great variation in region wise availability of agro residues by their type. For e.g the northern India is blessed with all the varieties of residues such as wheat straw, rice straw, bagasse , and few of the grasses ie sarkanda and sabai grass etc. On the contrary, the eastern India is strong in rice straw and jute stick production. The region wise availability of different agro residues are depicted in exhibit 7.01 below.

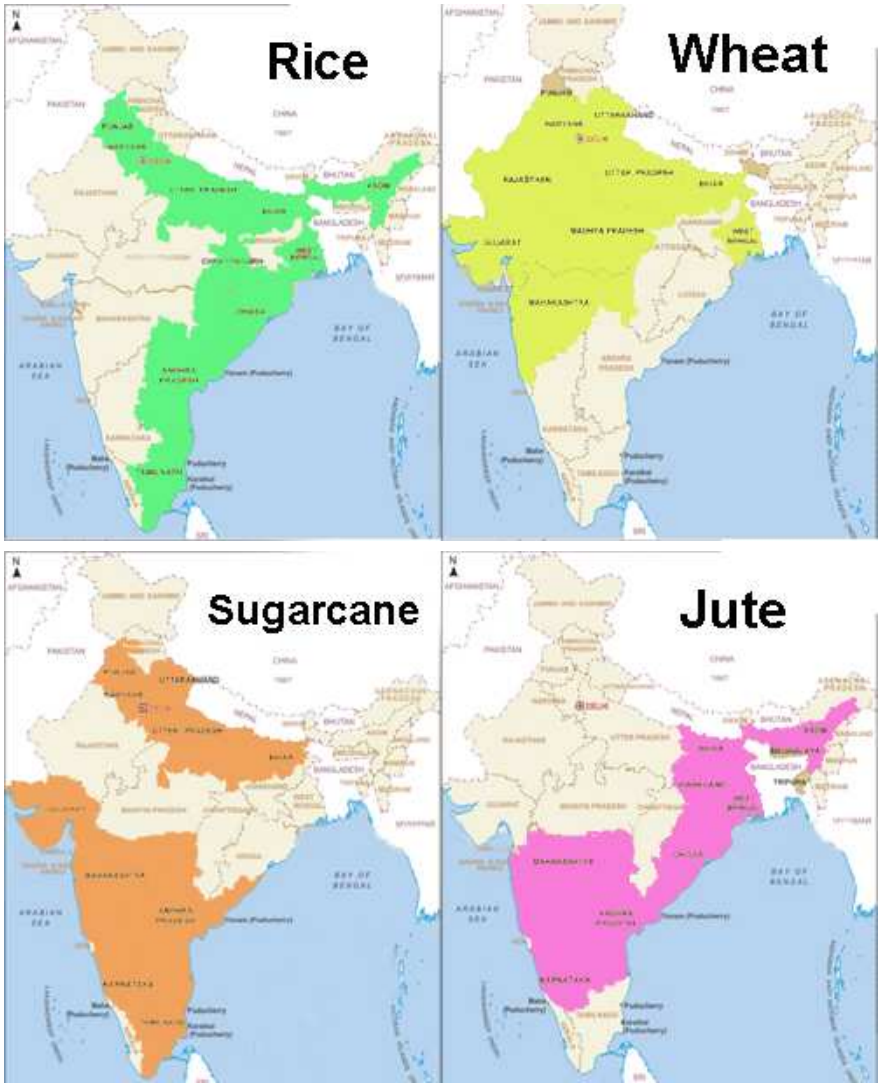


Exhibit 7.01: Region Wise Availability of Different Agro Residues

However, the grasses such as sarkanda, sabai grass and elephant grass etc. are available in patches throughout India. The net availability of the residues however depends on the harvesting method, recovery parameters and end use patterns etc.

7.4 Harvesting Pattern

The harvesting patterns of agriculture crops have shown wide variance in different regions. It does not apply in case of bagasse since it is recovered in sugar mills and the country side jaggery/ khandsari units. In a way, the processing months starting from September to March are the harvesting or recovery months for bagasse. The harvesting pattern for wheat and rice is discussed in this paragraph.

7.4.1 Wheat

The major states producing wheat are Haryana, Punjab, Uttar Pradesh, Bihar, Rajashtan and also Uttarakhand, Gujarat, Maharashtra, Madhya Pradesh and West Bengal to some extent. There are two types of harvesting practices namely manual and mechanized. The mechanized harvesting is done through combine harvesters, mostly prevalent in Punjab, Haryana, Gujarat, Western and Central U.P,

and Rajashtan. In other states combine harvesting is limited and they depend mostly on manual harvesting. A combine harvester harvesting wheat can be seen in Exhibit: 7.02

Exhibit- 7.02 : Combine Harvester in Operation

The harvesting done by combine harvester leaves about 12-18 inches of the stalk in the field. In process substantial amount of fiber (about 30-40%) is lost. Interaction with combine harvester operators has revealed that it is not possible for them to cut the plant from the bottom due to higher operational cost. A field harvested by combine harvester with left out portion of wheat plant can be seen in Exhibit- 7.03

Exhibit – 7.03: Wheat Field Harvested By Combine Harvester

On the contrary in manual harvesting only about 2-6 inches of stalk are left in the field. In process the fibre recovery is up by 30-40%. The situation can be seen in Exhibit 7.04.


Exhibit- 7.04: A Manually Harvested Wheat Field

The practices not only result in loss of valuable fiber either left in the field or burnt but also a financial loss to the farmers. The comparative loss to the farmers will be discussed at a later part of this chapter. In selected areas the harvesting modes prevalent are given in Table: 7.08.

Table-7.08

Variety Wise Cultivation of Wheat & Harvesting Mode (% of HH)

Sl No.	District		Major Varieties of Wheat Under Cultivation								Mode of Harvesting	
											Manual	Mechanical/ Combined
1	Ahemadnagar	Varieties	496	2189	1289	1906					2	98
		% of responses	67	20	4	9						
2	Amravati	Varieties	Bipass	Narmada	Lokwani	Patti Pass	Nagrati	Bon Paudi	Mukul Pass	Others	79	21
		% of responses	27	11	15	14	6	10	8	9		
3	Deoria	Varieties	UP 262	56	54	Aara 21					64	36
		% of responses	78	7	6	9						
4	Muzzafernagar	Varieties	226	43	4375	343	Others				72	28
		% of responses	35	7	11	21	26					
5	Punjab	Varieties	343	43	PW-43	242	others				2	98
		% of responses	65	13	9	6	7					
6	Sitamarhi	Varieties	UP 262	54	Aara 21	others					73	27
		% of responses	56	13	18	13						
7	Pilibhit	Varieties	UP 262	56	54	Aara	Others				67	33
		% of responses	52	31	9	5	3					

Source: Field Survey

7.4.2 Rice

The major regions cultivating rice are Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Chattishgarh, Andhra Pradesh and Tamil Nadu. However the crop is also cultivated to some extent in Maharashtra, Karnataka, Uttrakhand and few other states. Unlike wheat the harvesting pattern is different in case of rice. In the water logged areas the harvesting has to be done manually and the plant residues are to be left in the field due to high moisture content and problems in post harvest handling. In non water logged areas the harvesting is done both manually as well as mechanically. In the states like Punjab and Haryana harvesting by combine harvester is in vogue. However, in other parts of the country it is mostly manual. Again the combine harvesters leave about

2-4 ft of plant in the field and in case of manual harvesting about 6-12 inches of plants are left in the field. The fibre loss in case of mechanized harvesting exceeds 50% which is a net loss to both the farmers as well as the quality fiber. A manually and mechanically harvested field can be seen in Exhibit-7.05.

	
Exhibit 7.05 **Manually Harvested Rice Field in Dry Land in Andhra Pradesh**	**Manually Harvested Rice Field in Waterlogged Area of Bihar**

Amongst the areas surveyed, rice was found being harvested mechanically in Punjab, Haryana, and western Uttar Pradesh. In Punjab and Haryana the straw left in the field are mostly burnt after harvesting in order to sow the next crop. The field findings in this context are elaborated in table 7.09.

Table – 7.09

Percent Cultivators Variety-wise and Harvesting Mode **(% HHs)**

Sl No.	District	Major Varieties of Wheat Under Cultivation									Mode of Harvesting	
											Manual	Mechanical / Combined
1	**Deoria**	**Varieties**	Parmaal	Mansuri	Basmati	Jaya	Others				82	18
		% of responses	48	31	7	5	9					
2	**Muzzafernagar**	**Varieties**	Basmati	1121	48	Tural	2511	PR-14	999	Others	88	12
		% of responses	36	22	7	4	3	6	6	16		
3	**Punjab**	**Varieties**	44	1121	201	118	others				6	94
		% of responses	41	16	11	7	25					
4	**Sitamarhi**	**Varieties**	Mansuri	Jaya	Basmati	Pankaj	Parval	others			82	18
		% of responses	44	20	13	7	6	10				
5	**Madurai**	**Varieties**	IR 20	CD 43	AD 32	Sirla Purni	Kalur Purni	Othrers			96	4
		% of responses	39	13	12	11	16	9				
6	**West Godavari**	**Varieties**	Swarna	6400	1010	6410	others				92	8
		% of responses	39	30	8	5	18					
7	**Pilibhit**	**Varieties**	Mansuri	Jaya	Basmati	Parval	others				88	12
		% of responses	45	22	8	3	22					

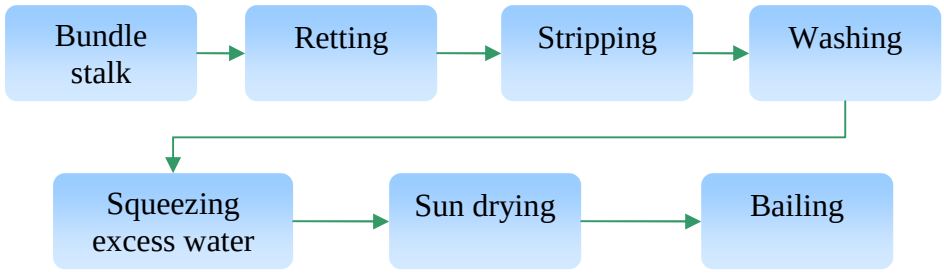
Source: Field Survey

7.4.3 Jute

Jute is found mostly in the eastern India e.g Bihar, West Bengal, Assam etc. However its variants such as kenaf and mesta are mostly cultivated in Andhra Pradesh.

The peak harvesting months for jute are September and October. The crop is ready for harvesting when it is in small pod stage. If harvested before, the fiber is weak while if left until the seed is ripe, the fiber is stronger but is coarser and lacks the characteristic luster. The plants are left in small heaps at different places in the field for two to four days when most of the leaves get dried up. After this period the plants are tied into bundles. At the time of bundling most of the leaves shed on the ground. The colour of the fiber is darkened if the leaves are allowed to remain during the process of retting. It is also thought that drying of the plants before retting facilitates the separation of the fiber. The bundles are then taken for steeping in water. In low lands where jute plants may be standing in water, steeping is carried out immediately after harvest. Jute harvesting has a multi stage process as shown in flow chart below:

Flow chart of jute processing



However, recovery of stalks initiates at the stage of retting itself and ends at stripping stage. Retting is a process by which fibers in the tank get loosened and separated from the woody stalk due to the removal of pectinals and other mucilaginous substances. This is usually affected by the combined action of water and micro-organisms. The tied bundles of jute stalks are taken to the tank or ditch for retting. The bundles are steeped in water at least 60 to 90cm in depth. Jute bundles rot better when steeped out at a depth of 15cm to 23cm below the surface in slow flowing clean water. The retting process is completed in 8 to 30 days.

When the barks separate out easily from the stick or wood retting is completed. When retting is complete, fibers are ready for extraction. Fibre must be extracted as quickly as possible otherwise the quality will suffer.

Stripping is a process of removing the fibers from the stalk after the completion of retting. Generally the fibers are removed from the stalk by any of the three methods. In the first method single plants are taken and their fibers are taken off. This method though very slow, results in good quality of fibers as it is free from pith, etc. The second method implies taking off a handful of stalks breaking at one end and stripping off the fibers by dashing it in a to and fro motion in water. The third method consists of washing the stalks first by standing in waist deep water and then stripping afterwards. Jute crop being harvested can be seen in exhibit 7.06.

Exhibit 7.06: Jute being harvested

7.4.4 Sugarcane (Bagasse)

The major states producing sugarcane are Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Tamilnadu, Punjab and Bihar etc. However few of the other states also cultivate sugarcane to a lesser extent. The only by-product of sugarcane which is used for paper making is bagasse which is recovered at the Sugarmill or jaggary/khandsari units. The bagasse recovery starts in the month of October and continues till March-April. The bagasse recovery from sugar mill can be seen in 7.07.

Exhibit 7.07: Baled Bagasse

7.5 Residue Recovery Pattern

7.5.1 Wheat Straw

The field surveys have revealed a wide variance in recovery of agro residues from region to region. For eg. for wheat straw the average straw yield ranged from 2.81 tons per ha. in Muzaffar Nagar to 3.83 in Barnala/Sangrur and Pilibhit. In Deoria district of Uttar Pradesh the wheat straw yield is 3.21 tons per ha.. The zonal variation in recovery pattern can be seen in Exhibit 7.08.

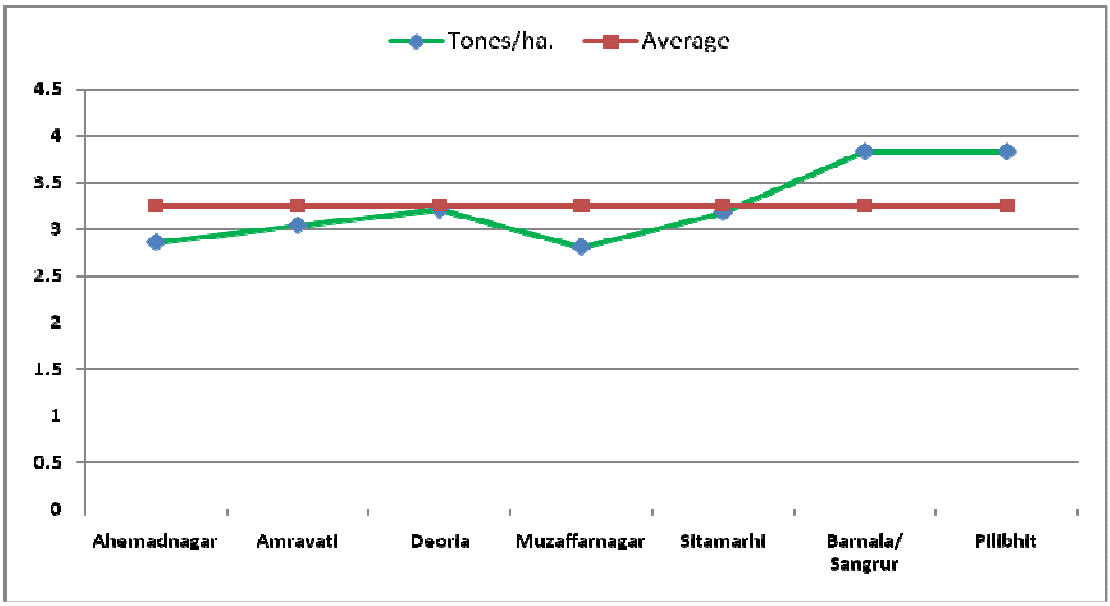


Exhibit 7.08 Out-turn of Wheat Straw per ha

Table - 7.09

Out-turn of wheat straw per ha.

District	Tones/ha.
Ahemadnagar	2.86
Amravati	3.04
Deoria	3.21
Muzaffarnagar	2.81
Sitamarhi	3.18
Barnala/Sangrur	3.83
Pilibhit	3.83
Average	**3.25**

Source: Field Survey

However, similar studies conducted in past indicate that wheat grain to wheat straw ratio is about 1:1.47 i.e each kg. of wheat grain produced yields about 1.47 kg of straw. Depending upon productivity and variety of crop being cultivated both the figures match to each other.

7.5.2 Rice Straw

The earlier studies indicate a rice straw recovery in relation to paddy grain produced i.e grain to straw ratio is 1:0.65. In other words, each kg. of paddy produced yields about 0.65 kg. of straw. Again, the variations do take place due to difference in variety of paddy as well as the soil moisture condition in a particular region. The field findings on the subject are depicted in Exhibit 7.9 and Table 7.10.

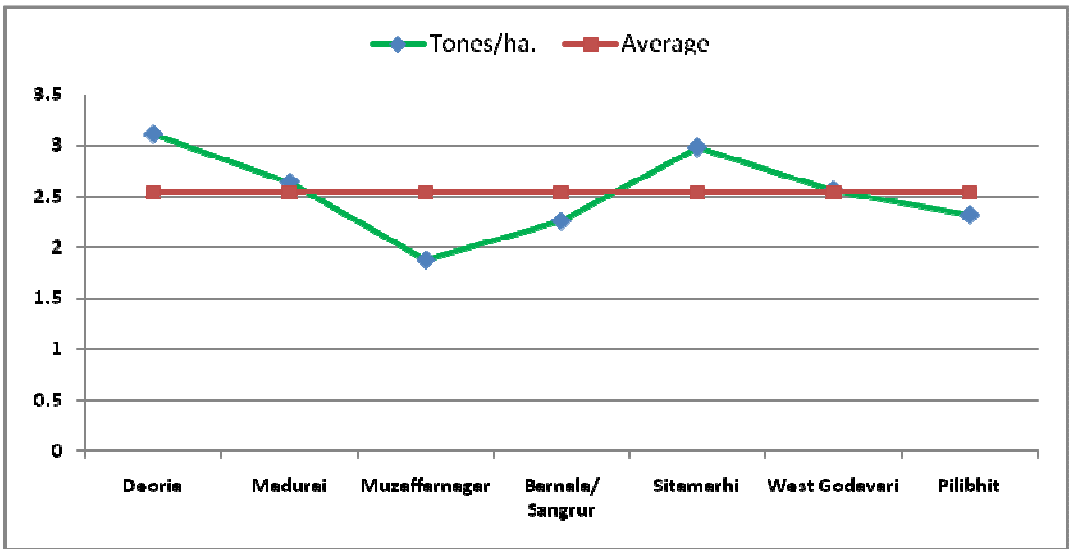


Exhibit -7.9: Out-turn of Paddy Straw per ha.

Table -7.10

Out-turn of Paddy Straw per ha.

District	Tones/ha.
Deoria	3.11
Madurai	2.64
Muzaffarnagar	1.88
Barnala/Sangrur	2.26
Sitamarhi	2.98
West Godavari	2.56
Pilibhit	2.32
Average	**2.54**

Source: Field Study

Out-turn of paddy straw varies widely from 1.88 tonne/ha. in Muzaffarnagar to 3.11 tonne/ha in Deoria. The variations are high owing alliance to the reasons such as variety of paddy i.e plants height ranging between as low as 2 ft. to 5.5 ft. The paddy varieties with higher height yields more straw and are necessarily the coarse varieties of paddy. The Basmati and IR-8 varieties yield very small quantity of rice straw. Even the harvesting pattern has shown impact on the straw recovery. In comparison with grain to straw ratio, the area related findings are also accurately matching since one hectare of land yields about 4 tons of paddy and hence generates 2.6 tons of straw on an average.

7.5.3 Bagasse

In India bagasse recovery strongly depends on type of sugarcane used. It has been noticed that in case of ratoon the recovery of bagasse is about 40% of cane crushed. However there are better juicy varieties yielding hardly about 30% bagasse. On an average about 33% of sugarcane crushed result into bagasse. However, the surplus bagasse depends on quality of boiler and cogeneration facility with the unit after burning as boiler fuel. The bagasse recovery at jaggery/khandsari units are more than 35-40% of sugarcane crushed but almost entire quantity is used as fuel.

7.5.4 Jute/Kenaf/Mesta

These crops belong to the same family but with difference in fiber and woody core recovery. This woody core portion of the plants is used for paper making. The field findings reveal that one tonne of jute fiber produced yields about 2.5 tons of jute stalk. Similarly, kenaf and mesta, belonging to hibiscus family, yields 1.85 tons of stalk for every ton of bark fibre produced. The regional variation has not been noticed since only one part of the country's geography has been surveyed for the purpose. Within a given geography the variations found are of negligible extent.

7.6 Post Recovery Practices

Once the residues are recovered, the post recovery practices include burning of the residues, composting, use as fuel, storage for cattle feed, and peak season and off season sales. The practices for different residues are elaborated in succeeding paragraphs.

7.6.1 Wheat Straw

Wheat straw recovery takes place either in form of long straw or short straw. In case of grain separation if it is thrashed mechanically the straws recovered are very small in size raging between 2-4 cm. Wheat straw being recovered through thresher is shown in Exhibit- 7.10

Exhibit 7.10: Threshing of Wheat Straw through Thresher

Threshing is done mostly in cases of crops harvested through manual method. In case of combine harvesting the grain is separated in situ. The recovered straw is mostly stored in covered places to protect it from moisture, wind and heat. In Bihar it is stored in makeshift cottages made of hays. In

Southern India the wheat straw heaps are covered by rice straw to protect it from natural calamities. Incidence of baling of wheat straw could not be traced in all the six states under investigation. The straw stored is either used for cattle feed or sold to the end users during the off season. The threshing done through oxen can be seen in Exhibit 7.11.

Exhibit 7.11: Wheat Threshing through Oxen

7.6.2 Rice Straw

Irrespective of the harvesting method used, rice straw is found in longer size. The grain separation is done either through combine harvesters or manual beating against hard surfaces or through oxen. Grain separation through oxen is shown in Exhibit- 7.12.

Exhibit 7.12: Rice Threshing by Oxen

In Punjab and Haryana the straws are burnt right in the field since cost of collection is higher and the farmers want the field ready for the next crop. In other parts of the country this is stored in heap form to meet cattle feed demand and off season sales. The storage is made in open with steep slopes as shown in Exhibit- 7.13.

Exhibit: 7.13 Rice Straw Stored in Heap

7.6.3 Bagasse

After recovery, bagasse is left in the open within sugar mill premises in loose form. However some of the sugar mills also get it baled in sizes of 15, 20, 25 and 30 kg bales. The baled bagasse is already shown in Exhibit 7.07 of this report. If Bagasse to be used for captive consumption in cogeneration or distillery plants, it is not baled. However, if to be sold, it is supplied in both the form i.e loose or baled.

7.6.4 Jute/Kenaf/Mesta

The sticks recovered from these crops are mostly used as fuelwood by the farmers. These sticks are very useful fibrous material for paper making but due to lack of paper mills in the vicinity the storage system has not been developed. The farmers after de-barking the jute fibers use it either for thatching or for fuel or abandon it in situ. Being hygroscopic in nature it cannot be stored for 3-4 months since it starts losing its fiber quality. The temporary storage system includes bundling of the sticks and staking them vertically in the open or the covered areas. Jute stick bundles stalked can be seen in Exhibit 7.14.

Exhibit 7.14: Bundled Jute Stalks for Temporary Storage

7.7 End Use Pattern

7.7.1 Wheat Straw

The utilization pattern of wheat straw by the farm households is given in Table 7.11.

Table - 7.11

District Wise Wheat Straw Utilization Pattern **% of respondents**

% of Straw	1-10%	11-25%	26-50%	51-75%	76-100%
Ahemadnagar					
Compost	34	1			
Domestic Use	5	1	1		
Fodder	50	9	1	1	
Sold	2	1			
Burnt	1	1	16	35	44
Amravati					
Compost	61	1			
Domestic Use	20	4	1		
Fodder		1	6	34	53
Sold	2	1			1
Burnt	2		1		
Deoria					
Compost	2	1			
Domestic Use	5	4			
Fodder	1	1	2	5	91
Sold	1				
Burnt					
Muzaffarnagar					
Compost	8	3	1		
Domestic Use					
Fodder		1	1	9	88
Sold					
Burnt					
Punjab					
Compost					
Domestic Use					
Fodder		12	41	7	21
Sold		3	59	5	10
Burnt					
Sitamarhi					
Compost					
Domestic Use	4	2	1		

Fodder		1	1	4	92
Sold	1				
Burnt					
Pilibhit					
Compost					
Domestic Use	36	18	2		
Fodder		11	48	14	3
Sold	2	12	32	3	
Burnt					

N.B. Balance of the sample did not respond

The wheat straw utilization pattern varies widely region wise depending upon the trading, domestic usage and livestock feeding patterns. In Ahemadnagar district the use of wheat straw skews towards burning and fodder purposes. About 80% of the respondents confirmed that they use more than 50% of the residues produced for burning. About 59% opined that they use upto 25% of residues recovered for fodder purposes.

In Amravati, 87% of respondents uses more than 75% of residue for fodder purposes while 61 % are using the residues (up to 10%) for compost preparation. In Deoria, Muzaffarnagar and Sitamarhi agro residues are mainly used for fodder. In these locations 75-100% of straw recovered are used for fodder by more than 95% respondents.

In Barnala/Sangrur and Pilibhit 25-50% of wheat straw recovered is being sold to paper mills by 60% and 32% farmers respectively. In these districts for fodder, 24-50% of recovered residues are being used which was revealed by 40% and 48% farmers respectively. One of the most common findings of field investigation reveal that when grain separation is done through mechanized threshers the recovered straw are necessarily used for fodder purposes being small sized particles.

It would be observed that except in Punjab commercial sale of wheat did not take place to any significant extent in other parts of the country. 77% of sample farmers sold wheat straw to varying extent of their out turn.

7.7.2 Marketing of Wheat Straw

Punjab is the only state where farmers get significant income from wheat straw where 77% wheat cultivators sell the straw. The straw is sold by and large to traders (76%) and rarely directly to the industry (1%). The price is negotiated by the buyers who approach the farmers after the harvest and lift it for delivery at the farm gate. In case of sale to the industry the farmer delivers at mill gate at negotiated price which includes transport and handling (loading/ unloading) charges. The prices ruled between Rs. 2500 to Rs. 3000 per tonne during the last wheat harvesting season. The farmers are satisfied with the price realization. The commercially transacted straw is sold off immediately after harvest. Even though farmers are generally aware that they could realize much higher price after two

to three months of the peak period, they do not hold on to stocks because of lack of storage space for the bulky material.

7.7.3 Rice Straw

The pattern of utilization of rice straw in rice producing states is similar to that of utilization of wheat straw.

The utilization pattern of rice straw across the districts may be seen in Table-7.12. The only district where this item is commercially transacted is West Godavari. Otherwise rice straw is utilized entirely within the farm system as manure or fodder.

Table – 7.12

District Wise Rice Straw Utilization Pattern **% of respondents**

% of Straw	1-10%	10-25%	25-50%	50-75%	75-100%
Deoria					
Compost	12	2			
Domestic Use	34	5			
Fodder			1	7	86
Sold					
Burnt					
Madurai					
Compost	31	16	7	1	
Domestic Use	28	6	3		
Fodder		15	15	24	44
Sold					
Burnt	1	19	7		
Muzaffarnagar					
Compost		1			
Domestic Use	1				
Fodder	2	11	2	2	46
Sold					
Burnt			9	3	2
Punjab					
Compost					
Domestic Use	1	1			
Fodder					
Sold					
Burnt			2	3	91
Sitamarhi					
Compost	3	2			

Domestic Use	9	3	1		
Fodder				11	77
Sold					
Burnt	1	1			
West Godavari					
Compost	54	4			
Domestic Use	74	12			
Fodder	2	55	5	7	30
Sold		2	51	8	
Burnt					
Pilibhit					
Compost	2				
Domestic Use	12	14	2		
Fodder			5	12	76
Sold					
Burnt					

The utilization pattern of rice straw somewhat is similar across regions with mostly usage as fodder and domestic uses. In Deoria, Muzaffarnagar, Sitamarhi, and Pilibhit about 75-100% of rice straw recovered is used for cattle feed purpose which was supported by 86%, 46%, 77%, 76 % of responses respectively. In these regions the use of residue for domestic use and compost making is below 10%. In Barnala/ Sangrur farmers burn the rice straw (75-100% of recovered quantity) in the field itself to make the field ready for the next crop and lack of storage facility. This was supported by 91% of the respondents.

However in West Godavari and Madurai the responses were even for different uses. In Madurai the responses were evenly distributed between percentage of usage and number of responses about the use of rice straw for compost making, domestic uses and fodder purposes. The number of responses varied between 15-40% responses. In West Godavari, most of the respondents revealed that less than 10% of the recovered rice straw is used for compost and domestic use. About 85% of respondents revealed that they use less than 25% of recovered residue for domestic use and 54% of respondents confirmed that less than 10% of residue recovered is used for compost making. 50% of the responses supported that about 25-50% of the residue is used for fodder purposes.

It would be seen that only in West Godavari district rice straw is offered for commercial sale to any significant extent. 8% farmers could sell more than 50% of the produce of their straw and 51% farmers sold 25% to 50% of their produce.

7.7.4 Marketing

In West Godavari 61% of the rice straw recovered is sold. Generally the industry agents contact the farmers within a month of harvesting in the farm and pick rice straws from the farm at pre-negotiated price. The per ton price last season ranged between Rs. 300 to 500.

The farmers are satisfied with the price realization but they have could realized better price if they hold the rice straw for a few weeks after harvesting. They prefer to sell to the agent because they lack storage space for rice straw.

7.7.5 Bagasse

Bagasse being an industrial by-product has well defined end use segment for itself. On an average 33% of the sugarcane crushed is bagasse. Depending on the type of boiler, the net surplus of bagasse with sugar mills ranges between 4% to 9% which is averaged at about 6 %. In other words about 12% of bagasse recovered is the net surplus with the sugar mill provided they do not have cogeneration facility or distillery or other downstream products to feed. The other end uses of bagasse are mushroom production, biomass based power plants, paper, furfural and composting etc. The regional variations in end uses can be seen in Exhibit 7.15.

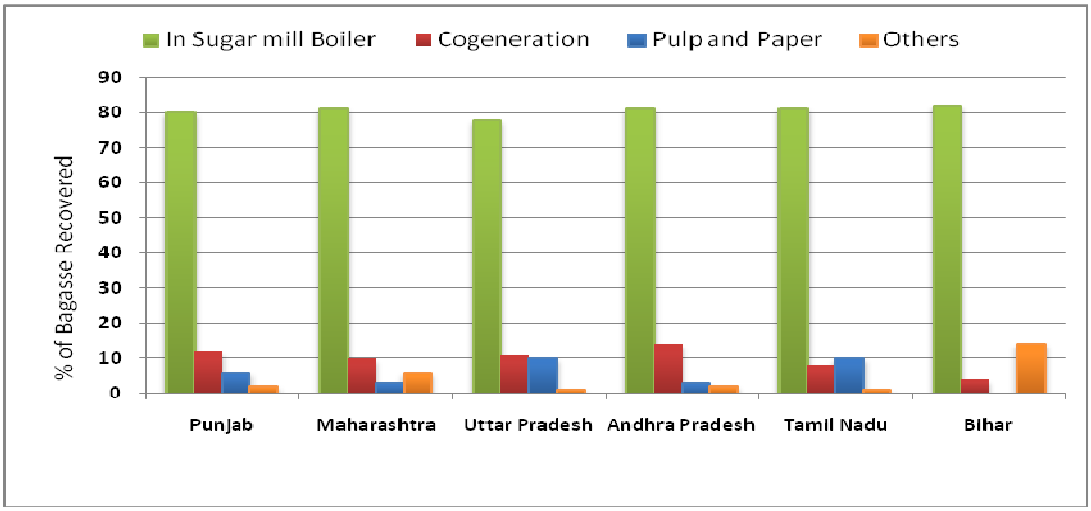


Exhibit 7.15: Regional Variation in End Use of Bagasse

Table 7.13

Regional Variation in End Use of Bagasse

% of Bagasse Recovered

	In Sugar mill Boiler	Cogeneration	Pulp and Paper	Others
Punjab	80	12	6	2
Maharashtra	81	10	3	6
Uttar Pradesh	78	11	10	1
Andhra Pradesh	81	14	3	2
Tamil Nadu	81	8	10	1
Bihar	82	4	-	14

Source: Field Survey

7.7.6 Jute/Kenaf/Mesta

Uses of jute/kenaf/mesta stalks have not received much industrial importance. Nearly 98% of them are used for non productive purposes such as fuel wood, temporary thatching etc. Only about 2% reaches to industries for pulp and paper, particle board and jute composite products.

7.7.7 Grasses

Some kind of grasses have also been found suitable for paper making and are being utilized in some of the paper mills as a comfortable cellulosic raw material. These grasses are available in various parts of the country. However their procurement and disposal are not fully organized as yet. But some proportion grasses grown on Government lands are auctioned from time to time.

The availability and their use for paper making have been estimated as shown in table 7.14.

Table 7.14

Availability of Grasses

Type of Grasses	Estimated use in Paper Making (Tonnes)	Estimated Availability per Year (Tonnes)
Khar, (*Saccharam munja S.bengelsenses)*	44,000	2,00,000
Kahi, (*Saccharam spontancoum)*	86,000	5,50,000
Babhar *(Eulaiopsis sabai binata)*	82,000	3,50,000
Dhah/Durva *(Desmussta-bipinnata)*	Small	In Abundance
Vllethemed daarundinacea	-do-	-do-
Geners/Bharwan *(Themeda quardrivalvia)*	-do-	-do-
Nech.khaskhas *(Vetivera sozenoides)*	-do-	-do-
Kuneria/Khar *(Heteropogon contourtus)*	-do-	-do-
Bansi (*Pharagnites kaska)*	-do-	-do-

Source: Discussion with Paper Industries

In addition to paper making majority of the grasses are used for rope making, extraction of essential oils and thatching etc.

7.7.8 Rice Husk

Rice husk is the outer most layer of paddy grain, separated from the grain during rice milling. Depending on variety of paddy the recovery rate of rice husk differs. However, in India on an average 25% of the paddy weight is taken as rice husk. It is produced in the first step in the milling process when the husk is removed from the grain in the husking stage of the rice mill. Rice husk are now being used as fuel to feed the boilers in different industry including pulp and paper industry. The major characteristics of rice husk are:

- Rice husk is difficult to igninte and it does not burn easily with open flame unless air is blown through the husk. It is highly resistant to moisture penetration and fungal decomposition. Husk therefore makes a good insulation material.
- Rice husk has a high silica (SiO_2) contents which means that it decomposes slowly when brought back to the field. It also makes it a poor fodder
- Handling of rice husk is difficult because it is bulky and dusty. It has angle of repose is about 40-45° which means that it's flow ability, e.g. in feed hoppers is very poor.
- Rice husk has low bulk density of only 70-110 kg/m³, 145 kg/m³ when vibrated or 180kg/m³ in form of brickets or pellets. It thus requires large volumes for storage and transport, which makes transport over long distances un-economical.
- When burned the ash content is 17-26%, a lot higher than fuels (wood 0.2-2%, coal 12.2%). This means when used for energy generation large amounts of ash need to be handled.
- Rice husk has a high average calorific value of an 3410 kcal/kg and therefore is a good, renewable energy source.
- Because of the high silica contents rice husk is very abrasive and wears conveying elements very quickly.
- Rice husk is not an easy fuel. One concern in rice husk firing is the behavior of the ash, i.e., its slagging and fouling tendency caused by a low melting point of the rice husk ash.

Pulp and paper industry by using it as fuel is further contributing to the farmers economy since in present context it is sold @ Rs. 4,000 a ton.

7.8 Price and Price Pattern

The prices of agro residues have shown wide intra-regional differentials owing alliance to factors such as their availability, end uses and presence of end use industries.

The field findings reveal that prices of residues are higher where the industrial demand exists. It has also been noticed that if the residues are sold for cattle feed purpose in urban areas, the retail prices are almost double of the collection prices and are extremely higher during off-season purchases. The prices shown here belong to the delivered prices at industry gate or the cattle feed retail outlet. The prices of different residues are given in Table 7.15.

Table 7.15

Region wise Prices of Different Agro Residues **Rs./Ton**

Regions	Residues	Wheat Straw	Rice straw	Jute/Kenaf/ Mesta stalks	Grasses	Bagasse
Sangrur* (Punjab)	For Paper Plants	3400-3700	-	-	2400-2500	3000-3400
	For Power Plants	-	1000-1100	-	-	-
	For Cattle feed	3400-4000	-	-	-	-
Muzaffarnagar* (Uttar Pradesh)	For Paper Plants	2700-3100	-	-	2200-2500	3000-3500

	For Power Plants	-	-	-	-	-
	For Cattle feed	3000-3700	-	-	-	-
West Godavari* (Andhra Pradesh)	For Paper Plants	-	500-800	800-900	-	3000-3400
	For Power Plants	-	1100-1200	800-900	-	2300-2700
	For Cattle feed	-	500-950	-	-	-
Pilibhit (Uttar Pradesh)**	For Paper Plants	2500-2900	-	-	-	-
	For Power Plants	-	-	-	-	-
	For Cattle feed	3000-3500	-	-	-	-
Madurai (Tamil Nadu)	For Paper Plants	-	-	-	-	2200-2700
	For Power Plants	-	300-400	-	-	2200-2500
	For Cattle feed	-	300-400	-	-	-
Sitamarhi (Bihar)	For Paper Plants	-	-	-	-	-
	For Power Plants	-	-	-	-	1900-2100
	For Cattle feed	2200-2300	550-750	-	-	-
Deoria (Uttar Pradesh)	For Paper Plants	-	-	-	-	-
	For Power Plants	-	-	-	-	1900-2100
	For Cattle feed	1900-2300	600-700	-	-	-
Ahemadnagar (Maharashtra)	For Paper Plants	-	-	-	-	-
	For Power Plants	-	-	-	-	3000-3500
	For Cattle feed	2200-2300	-	-	-	-
Amravati (Maharashtra)	For Paper Plants	-	-	-	-	-
	For Power Plants	-	-	-	-	3000-3500
	For Cattle feed	2000-2600	-	-	-	-

* Agro Paper Industry Cluster

** Supplying to Agro Paper Industry Cluster

In non-agro based paper plant areas wheat straw is mainly used as cattle feed with price band of Rs. 1900-2600 per tonne. In agro residue based paper plant areas the price of residues is Rs. 3000-4000 per tonne. In Sangrur, the wheat straw price varies between Rs. 3400-4000 per tonne for fodder but in case of supply to paper plants the price is Rs.3400-3700 with occasional price hike of up to Rs.4400/Tonne. The field study has revealed that due to high demand by paper plants and fodder purposes, there is little surplus available for use by power plants or mushroom industries.

In Muzaffarnagar the price level of wheat straw for paper mills is between Rs.2700-3100 /ton though the concentration of agro based paper mills is more in this area. However, for cattle feed the wheat straw is sold between Rs.3000-3700/ton. To meet the demand by the paper mills in Muzaffarnagar area, supply of wheat straw is made from Pilibhit area and the price hovers around Rs. 2500-2900 /ton.

However, the clusters without agro based paper mills use wheat straw mostly as fodder. In Sitamarhi and Ahemadnagar, wheat straw is traded for cattle feed at Rs.2200-2300/tonne whereas in Amravati and Deoria this price goes up to Rs.2600/ton with the average price being Rs.2100/ton.

The survey has identified that the rice straw based paper plants are clustered in Andhra Pradesh. Apart from use of rice straw in paper plants the other segments using the residue are power plants and cattle feed. However, prices offered by power plants are almost double than that offered by paper plants or cattle feed traders. In West Godavari Rs.500-800 per tonne is paid by the paper plants for rice straw.

In Punjab, though the burning of rice straw in the field is most prevalent, in some parts of Punjab the power plants collect the residues for their boiler. The power plants pay between Rs.1000 and Rs 1100 per ton for rice straw. In West Godavari the price paid by the power plants is little higher at Rs.1100-1200 per ton. In other parts of the country, use of rice straw as fodder for cattle asks for prices between Rs.300-950 per ton. In West Godavari this price is the highest with price band of Rs.500-950 per ton and in Madurai it is lowest at Rs.300-400 per ton. In Sitamarhi and Deoria the prices paid for one ton of rice straw is Rs. 600-700/ton.

Bagasse is the industrial by-product being used by sugar mills for their boiler or cogeneration units and paper plants. The prices offered by the paper plants vary widely across regions. In Punjab, the prices paid by the paper plants are Rs.3000-3400 per ton. Muzafarnagar being the sugar growing belt witnesses lower prices being paid by the paper plants for bagasse due to use of bagasse by sugar mills in cogeneration units. In Muzaffarnagar, Rs.3000-3500 per ton is paid by the paper plants for bagasse. However, in West Godavari this price varies between Rs. 3000-3400 per ton and in Tamil nadu it is Rs. 2200-2700 per ton.

Apart from use of bagasse by the paper plants, use in cogeneration by the sugar mills or power plants are also in vogue. In Ahemadnagar and Amravati, the price paid for bagasse is Rs.3000-3500 per ton which is higher than other parts of the country. In Deoria and Sitamarhi it is Rs.1900-2100 per ton.

Grasses such as Sarkanda and Sabai grass is also being used by the paper mills in Muzaffarnagar and Punjab. The prices of the grasses vary between Rs2200-2500 per ton depending upon availability.

Jute/Kenaf/Mesta stalks are used in paper plants and power plants in West Godavari only. The prices paid by paper plants or power plants varies between Rs.800-900 per ton.

Rural Indian farmers are extensively involved in agricultural activities. However the nature and extent of their involvement differs with the variations in agro-production systems. The mode of female participation in agricultural production varies with the land owning status of farm households. With the advent of use of machines in agricultural activities, the role of labourers has also changed. Of late the focus has shifted to use agricultural residues in paper making creating scope for farmers in socio economic development.

7.9 Farm Income Assessment

In this study the net availability of surplus agricultural residues has been estimated, which is being wasted presently. These residues can be used for productive purposes adding some additional income to the farmers' kitty. The subsequent paragraphs delineate the available surplus residues for the clusters under study and the nation as a whole.

7.9.1 Income Loss to the Farmers from Rice Straw

This study estimates farmers' income loss from sale of surplus rice straw if the wasted rice straw could have been brought to the commercial use. The methodology dimensions used for the likely net accrued income from surplus disposal with the farmers is as follows:

$$I = \sum_{n} \frac{P_n}{n} \times S \times S_1 \times S_2 \times \delta$$

Where,

I	=	loss of income of farmers from sale of rice straw
P_n	=	Selling price of the rice straw in the cluster
n	=	No. of responses with price differentials in the cluster
S	=	Total production of Rice grain per annum
S_1	=	65% representing ratio of straw to the rice production
S_2	=	Ratio of rice straw available for use as raw material (30% of straw produced)
δ	=	Variability factor for clusters of agro based and non agro based paper plants.

On Studied Cluster Level

The net income that the farmers could have realized from the surplus rice straw is estimated for selected clusters below. Exhibit 7.16 and Table 7.16 depicts the clusterwise loss to the farmers.

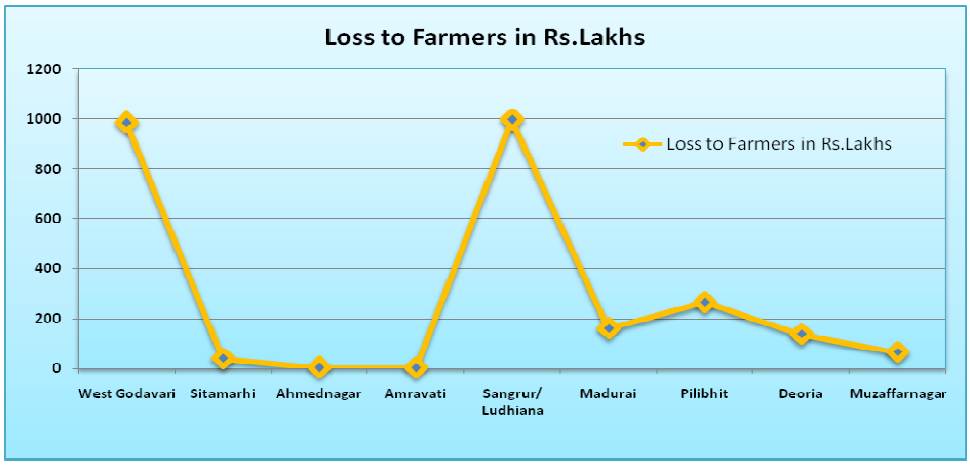


Exhibit 7.16: Cluster wise Loss to Farmers in Rs. Lakhs

Table 7.16

Cluster wise Income Loss to Farmers

District	Loss to Farmers (Rs. Lakhs)
West Godavari	986.8
Sitamarhi	39.6
Ahmednagar	4.1
Amravati	2.8
Sangrur	998.2
Madurai	160.0
Pilibhit	264.6
Deoria	137.2
Muzaffarnagar	65.1

Source Consultants Estimates Based on Field Findings

It is noticeable from the above table that in West Godavari and Sangrur the farmers are losing incomes from sale of rice straw which presently is either being burnt or disposed off or used for non productive purposes. In other districts such as Pilibhit, Deoria and Madurai significant loss of additional income to the farmers is noticed though the sale of rice straw is prevalent in little quantities for domestic uses or for fodder.

These are net availability of disposable rice straw with the farmers as other end uses e.g. use for fodder, thatching, domestic burning etc. have already been taken care of in the methodology above. It is noticeable that procurement by other industrial end users is almost nil in the present context.

On State Level

The study brings out that the average selling price of rice straw to the paper mills in Andhra Pradesh is Rs.650/Tonne and in Tamil Nadu it is Rs.350/Tonne. Basing upon this price the total income of the farmers in the two states calculates to Rs.7794.5 lakhs and Rs. 2222.7 lakhs respectively. The following table 7.17 delineates state wise loss of income from rice straw occurring to the farmers.

Table 7.17

State wise Income loss to Farmers

State/ UT	Loss To Farmers (Rs. Lakh)
Andhra Pradesh	7794.5
Arunachal Pradesh	99.6
Assam	2091.0
Bihar	2783.4
Chattisgarh	3418.8

Goa	76.6
Gujarat	928.6
Haryana	2276.2
Himachal Pradesh	76.5
Jammu & Kashmir	353.6
Jharkhand	2101.9
Karnataka	2341.7
Kerala	333.0
Madhya Pradesh	921.0
Maharashtra	1887.5
Manipur	255.9
Meghalaya	126.0
Mizoram	9.9
Nagaland	183.1
Orissa	4750.6
Punjab	6608.1
Rajasthan	163.5
Sikkim	14.4
Tamil Nadu	2222.7
Tripura	393.5
Uttar Pradesh	7421.4
UttaraKhand	373.6
West Bengal	9273.3
A & N Islands	13.8
D & N Haveli	14.9
Delhi	19.8
Daman & Diu	2.2
Pondicherry	33.6
All India	**59364.3**

Source: Consultants Estimates Based on Field Findings

The total loss to farmers in India is estimated to be around 593 crores. This loss arises from un-utilized rice straw. Exhibit- 7.17 depicts the statewise estimated loss occurring to farmers from the unutilized rice straw.

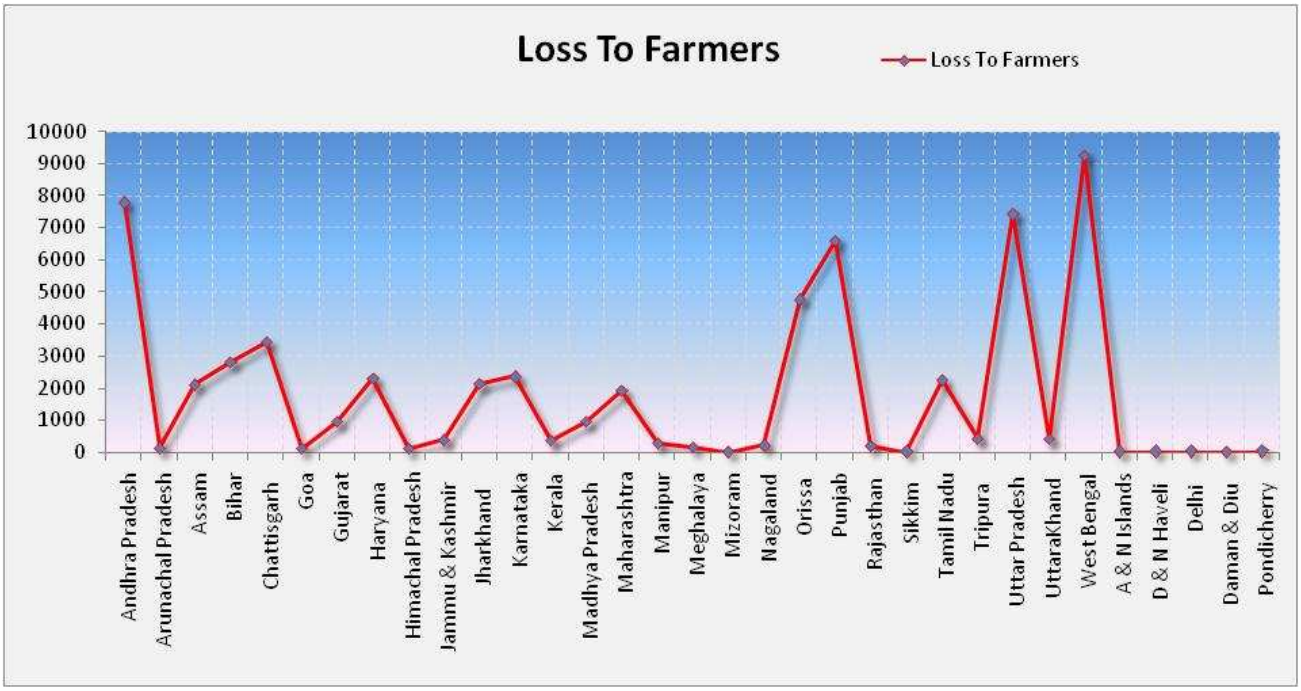


Exhibit- 5.17 State wise Income loss to Farmers (Rs. Lakhs)

7.9.2 Income loss to the farmers from Wheat Straw

This study estimates farmers' income loss from sale of surplus wheat straw if the wasted wheat straw could have been brought to the commercial use. The methodology dimensions used for the likely net accrued income from surplus disposal with the farmers is as follows:

$$I = \sum_{n} \frac{P_n}{n} \times S \times S_1 \times S_2 \times \delta$$

Where,

I	=	Loss of farmers
P_n	=	Selling price of the wheat straw in the cluster
n	=	No of responses with price differentials in the cluster
S	=	Total production of wheat grain per annum
S_1	=	147% representing ratio of straw to the wheat production
S2	=	Ratio of wheat straw available for use as raw material (10% of straw produced)
δ	=	Variability factor for clusters of agro based paper plants and non agro based

On Studied Cluster Level

The loss of income that the farmers could have realized from the surplus wheat straw is estimated for selected clusters below. Exhibit 7.18 and Table 7.18 depict the clusterwise loss to the farmers.

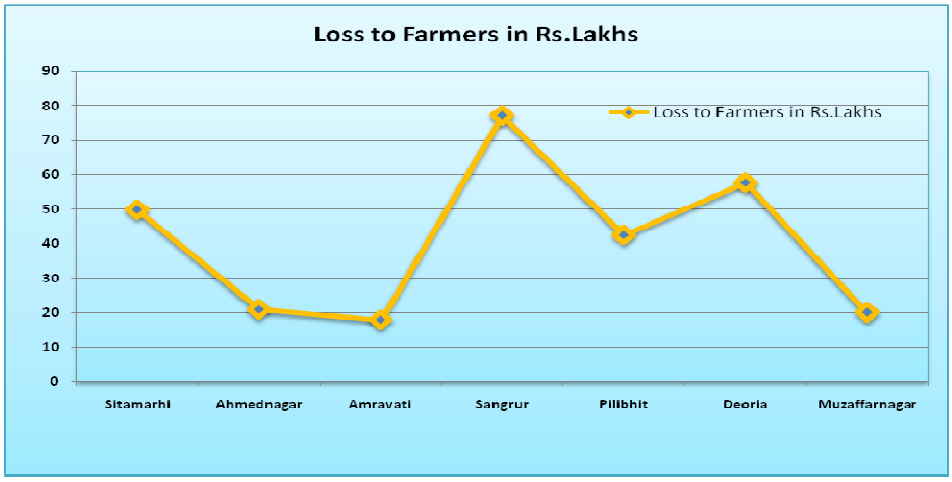


Exhibit- 7.18 Cluster wise loss to Farmers (Rs. Lakhs)

Table- 7.18

Cluster wise loss to Farmers in Rs. Lakhs

District	Loss to Farmers (Rs.Lakhs)
Sitamarhi	49.79
Ahmednagar	20.91
Amravati	17.91
Sangrur	77.08
Pilibhit	42.47
Deoria	57.68
Muzaffarnagar	20.04
Total	**285.89**

Punjab has shown the maximum potential of Rs.77 lakhs followed by Deoria and Sitamarhi. In Muzaffarnagar, though there is always scarcity of wheat straw, around Rs. 20 lakhs of loss is accruing to the farmers. In other districts of the survey area the farmers are losing a significant amount of additional income amounting to Rs. 2.86 crores.

On State Level

Table 7.19 brings out the state wise latent loss to the farmers from the wasted wheat straw.

Table- 7.19

State wise loss to Farmers

State/ UT	Loss to Farmers (in Rs. Lakh)
Andhra Pradesh	33.72
Arunachal Pradesh	15.64
Assam	209.46

Bihar	937.81
Chhatisgarh	291.47
Gujarat	1617.52
Haryana	1725.58
Himachal Pradesh	1062.89
Jammu & Kashmir	1044.98
Jharkhand	294.80
Karnataka	769.99
Madhya Pradesh	2542.39
Maharashtra	1375.06
Meghalaya	4.64
Nagaland	6.74
Orissa	25.67
Punjab	820.35
Rajasthan	300.28
Sikkim	18.97
Tamil Nadu	0.00
Tripura	8.01
Uttar Pradesh	1094.70
Uttaranchal	686.12
West Bengal	1546.38
D & N Haveli	4.64
Delhi	224.80
All India	**16662.59**

It is evident from the above table that in India farmers are losing about Rs. 167 crores from the surplus wheat straw which is presently being used for non-productive purposes. Madhya Pradesh loses about 25 crores being the largest loss bearing state. Gujarat, Haryana, Maharashtra and West Bengal are the other states with significant amount of surplus disposable wheat straw. Exhibit 7.19 depicts the state wise loss to the farmers from unutilized commercial potential wheat straw.

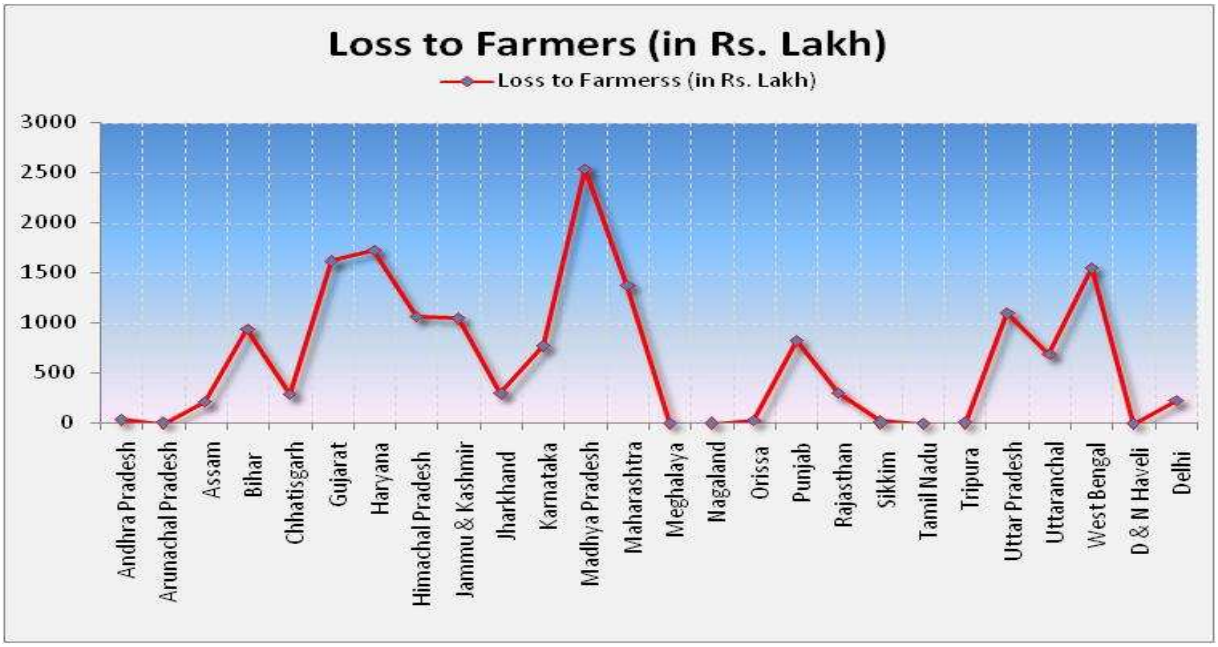


Exhibit- 7.19 : State wise loss to Farmers

7.9.3 Income loss from Jute/Kenaf/Mesta Stalks

Jute/Kenaf/Mesta is grown in selected parts of the country with limited use in paper industries though the quality of fibers in their stalks is suitable for paper making. The methodology dimensions used for calculation of net accrued income from disposable surplus with the farmers is as follows:

$$I = \sum_{n} \frac{P_n}{n} \times S \times S_1 \times S_2 \times \delta$$

Where,

I	=	Income of farmers from sale of Jute/Kenaf/Mesta stalks
P_n	=	Selling price of the jute/kenaf/mesta stalks in the cluster
n	=	No of responses with price differentials in the cluster
S	=	Total production of jute/kenaf/mesta stalks per annum
S_1	=	185% representing ratio of jute/kenaf/mesta stalk to jute/ kenaf/ mesta fibre
S2	=	Ratio of jute/kenaf/mesta stalk available for use as raw material (15% of stalk produced)
δ	=	Variability factor for clusters of agro based paper plants and non agro based

On State Level

The major jute/kenaf/mesta growing states in the states are west Bengal, Assam, Bihar and Andhra Pradesh accounting for 97% of the total jute/kenaf/mesta production in the country. West Bengal alone contributes 74% of total production of jute in the country. The stalks produced from these crops have multiple end uses but presently it is being used unproductively. Though West Bengal generates about 74% of jute/Kenaf/mesta stalk or wastes, the agro based paper mills existing in the state does not use jute stalks for paper making. Paradoxically, paper mills using jute/kenaf/mesta wastes are based in states that does not produce significant amount of jute/kenaf/mesta. Only Andhra Pradesh,

among the other potential jute producing states, harbours three paper mills using jute/kenaf/mesta wastes. Table 7.20 depicts the state wise total loss occurring to the farmers from unproductive use of jute/kenaf/mesta stalks which can be used in paper making.

Table- 7.20

State wise loss to Farmers

States	Price Loss to Farmers (Rs. lakhs)
Andhra Pradesh	200.20
Assam	273.21
Bihar	585.37
Chhattisgarh	1.08
Jharkhand	2.40
Karnataka	0.40
Madhya Pradesh	0.72
Maharashtra	13.19
Meghalaya	21.94
Nagaland	2.56
Orissa	60.38
Tripura	4.20
West Bengal	3314.08
Total	**4479.72**

It can be seen from that the total loss to farmers amounts to about Rs. 45 crores and in West Bengal it is Rs. 33 crores. The Exhibit 7.20 below brings out the farmers' loss of income due to non – commercial utilization of jute/kenaf/mesta.

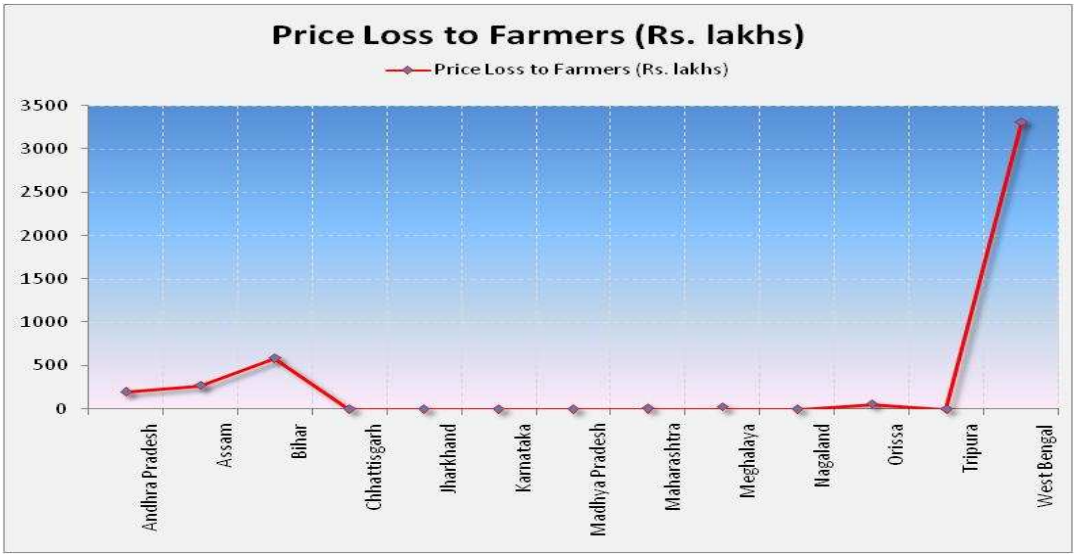


Exhibit- 7.20 : State wise loss to Farmers

7.9.4 Income Loss from Bagasse (Cluster Level)

Bagasse being an industrial by-product has additional income potential to the sugar mills. Bagasse is mostly being used as fuel either in cogeneration or biomass based power plants. In the process, an excellent fiber is lost which otherwise could have been used for paper making due to its good fiber properties. Presently, about 4% of total bagasse recovered remains as surplus which could be utilized either by paper mills or power generation units. Considering the prevailing price of bagasse with their regional variation, the total loss to the Sugar units has been estimated. The methodology dimensions used for estimating the likely net accrued income from surplus disposal with the sugar mills is as follows:

$$I = \sum_{n} \frac{P_n}{n} \times S \times S_1$$

Where,

I	=	Income loss of sugar mills from sale of bagasse
P_n	=	Selling price of bagasse for paper making in the cluster
n	=	No. of responses with price differentials in the cluster
S	=	Total Bagasse Recovered
S_1	=	4 % representing ratio of recovered bagasse to surplus bagasse

In clusters

Table 7.21 depicts the cluster wise total loss occurring to the sugar mills bagasse.

Table- 7.21

Cluster wise loss to Sugar Mills

Locations	Price Loss to Sugar mills (Rs. lakhs)
West Godavari	502.1
Ahmednagar	696.0
Amravati	12.0
Sangrur	1.2
Madurai	73.7
Pilibhit	451.8
Deoria	132.2
Muzaffarnagar	3843.4
Sitamarhi	16.3

It can be noticed that Muzaffarnagar followed by Ahmednagar and Madurai are the clusters where the sugarcane is grown in major quantities. Among all the surveyed clusters muzzafernagar shows major potential of bagasse generation and disposable surplus.

At State Level

Table 7.22 depicts the state wise total loss occurring to the sugar mills from unproductive use of bagasse which can be used in paper making.

Table- 7.22

State wise loss to Sugar Mills

STATES/UT	Loss to Sugar Mills (in Rs. Lakh)
Andhra Pradesh	4284.8
Assam	194.6
Bihar	518.8
Gujarat	3016.2
Haryana	1759.2
Karnataka	5210.2
Madhya Pradesh	631.4
Maharashtra	19837.7
Orissa	217.7
Punjab	1377.0
Rajasthan	117.9
Tamil Nadu	6329.5
Uttar Pradesh	21384.4
Uttaranchal	1526.1
West Bengal	252.6
All India	**66658.3**

Source: Consultants Estimate

The Exhibit 7.21 below brings out the farmers' loss of income due to non – commercial utilization of jute/kenaf/mesta.

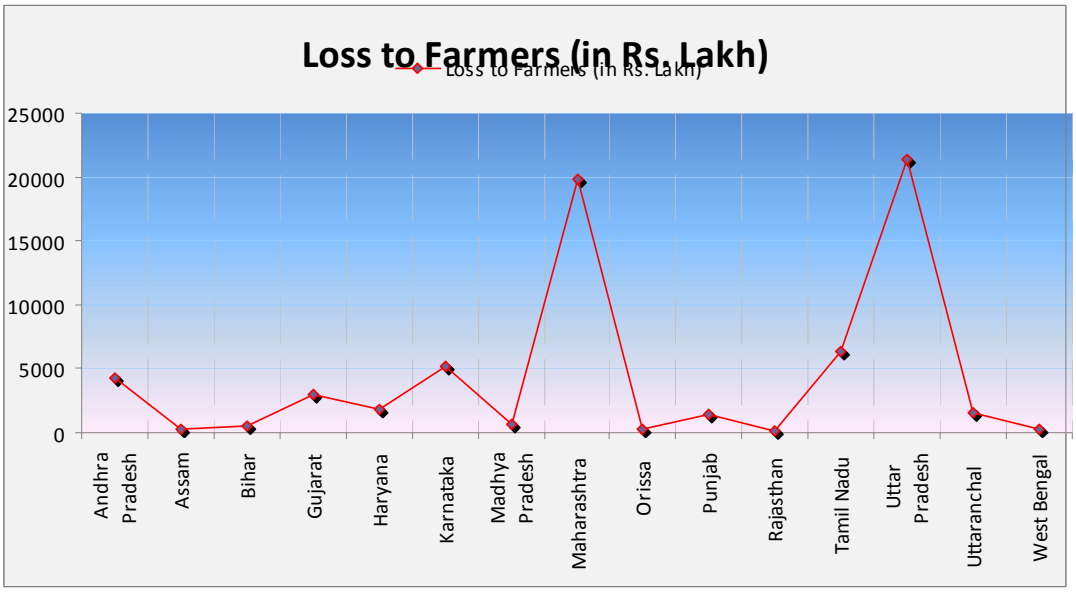


Exhibit- 7.21 Statewise Loss to Sugar Mills in Rs. Lakhs

It however should be noted that the income from bagasse does not go to the farmers and they are not the deprived lots. These incomes are enjoyed by sugar mills contributing substantially to their profitability both through sales to external sources as well as captive consumption in cogeneration and distillery plants. In both the cases bagasse is burnt and valuable fiber is lost. It is hence imperative to locate measures to solve this equation enabling sugar factories to avail alternative environment friendly and economic fuel and divert this precious fiber source to its ideal destination that is paper making.

7.10 Socio-Economic Relevance

The extent of income being derived from agro wastes and the extent of income which could have been derived further requires a comparative analysis. In both the situations the income received is subjected to multiplier effect which has its own impact on livelihood security framework, industrial growth, income and finally the National Income through income,saving, investment and finally the GDP . Environmental security is of course the most critical factor being/to be influenced by it. In this background, it will be interesting to look at the following statistics.

- Total production of paper (using agro residues) is 1748 thousand tonnes. Nearly 124 agro based paper units are manufacturing nearly 23% of the total volume of the paper and paper boards in India.
- Total quantity of agro residues being used in paper making is 4370 thousand tonnes.
- Average price at which agro residues are purchased by paper mills

Wheat Straw (Rs.)	Rice straw (Rs.)	Jute/Kenaf/ Mesta stalks (Rs.)	Grasses (Rs.)	Bagasse (Rs.)
2466-3233	500-800	800-900	2300-2500	2550-2940

- Total income to the farmers is Rs.810 crores.

	Bagasse	Rice straw	Wheat stRaw	Jute/kenaf/mesta	Grasses
Agro residue being used	1596000	638400	2447200	532000	106400
Avg. Price/Tonne	1787.5	650	2849.5	850	2400
Income in Rs. Lakhs	28529	4150	69733	4522	2554

- Agro residues being wasted in lack of demand or suitable procurement system is 19211 thousand tonnes.

Wheat Straw	**Rice straw**	**Jute/Kenaf/ Mesta stalks**	**Grasses**
2422 thousand tones	16205 thousand tonnes	556 thousand tonnes	28 thousand tonne

- Net loss to the farmers is Rs. 811.5 crore

Wheat Straw (Rs. crore)	**Rice straw (Rs. crore)**	**Jute/Kenaf/ Mesta stalks (Rs. crore)**	**Grasses (Rs. crore)**
166.63	593.64	44.79	6.44

Results of the Socio-Economic implications using Multiplier effects:

- Many families are directly employed in the paper mills
- Families are getting benefited through employment in raw material procurement, transportation, loading and unloading
- In Muzzafarnagar area, bagasse is procured from Kollu (Jaggery) units benefitting the families engaged in jaggery units
- The total surveyed paper mills with aggregate 730 TPD has directly generated about 14 lakh man days per year

Typical Socio-Economic impacts of an 100 TPD agro residue unit:

- Realization of wealth out of waste
- Necessarily to be located in rural area
- Residues used per day – 250 TPD
- Production of finished product – 100 TPD
- Direct Employment to 450-500 people
- Indirect Employment
    - Logistics:
    - Trucks required to bring raw material - 19 per day
    - Trucks required to transport of finished material- 7 per day

  - Loading and unloading: 332 man days per day
  - Transportation of goods and services: 20 man days per day
- Common Infrastructure facilities includes emergences of food outlets, grocery shops, petrol pumps, weigh bridges, fruit and vegetables, bank, post office and telecommunication services, cloth market, education institutions, spare parts and auto ancillary market. emergence of township.

Recommendations:

- Installation of fresh capacities of paper mills based on Agro Residue in clusters where there are no paper mills
- Encouragement to sugar mills to use fuel other than bagasse at least for cogeneration plants
- Encouragement to use mechanized harvesting and post harvesting practices to check fibre loss and make logistics easy by bailing
- Institutional arrangement for combined harvester cum baler cum trailer
- Policy initiatives to check burning of fibrous agro residues for power generation

ANNEXURES

Annexure 2.01

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format for Agro-residue based Paper Mills

1. Product mix

S No.	Type of paper manufactured	Appx. quantity manufactured (TPD)
1.		
2.		
3.		

2. Your preference for use of agro-residue (Indicate 1 for top preference in the box.)

a) Bagasse ☐

b) Wheat straw ☐

c) Rice straw ☐

d) Others (Specify)…….

3. How is the availability of agro-residues in your area

a) Available in abundance ☐

b) Availability is limited. Needs pre-planning ☐

c) Availability difficult. Tremendous effort is needed to procure required quantities ☐

4. Agro-residue being used

S No.	Type of Paper	Type of agro residue being used	Quantity of agro-residue being used /tonne of paper
1.			
2.			
3.			

5. Quantities of agro-residue being used

S. No	Type of agro-residue	Quantity procured per year
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Others (Specify)…….	

6. What are your sources of procurement of agro-residue? (Put ☑ on the source applicable.)

a) Direct from the farmers ☐

b) From the traders ☐

c) Through an agent appointed by you ☐

d) Any other source (specify)……..

7. Prices of agro -residue being used

S.No.	Type of agro-residue	Price Rs/Tonne Ex-farm
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Others (Specify)…….	

8. Distance-wise quantities of agro-residue procured.

	Share of Requirement (%)
a) from a radius of 10 km	…….
b) from a radius of 25 km	…….
c) from a radius of 50 km	…….

9. How do you transport the agro-residue to your factory?

a)	Trucks	☐	b)	Tempos	☐	c)	Bullock carts ☐
d)	Tractors	☐	e)	Head loads	☐	f)	Hand carts ☐

g) Any other (specify) ……

10. What are your terms of payment to the suppliers of agro residue

a) Cash on delivery ☐

b) Advance payment of …….. %

c) On credit of …… days

11. What do you think, are the constraints in using agro-residue

12. What advantage the farmers are deriving from your paper mill.

Name of Company …….

Address…….....

Respondent's Name……..... Designation……....

Phone No……..…… Fax ....…….. …

Email ……..

Website……

Date……..Interviewer's Name…….. ..

Annexure 2.02

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format for Power Plants using Agro-residue

1. **Capacity of power plant …… MW**

2. **Your preference for use of agro-residue (Indicate 1 for top preference in the box.)**

a) Bagasse ☐

b) Wheat straw ☐

c) Rice straw ☐

d) Others (Specify)…….

3. **How is the availability of agro-residues in your area**

a) Available in abundance ☐

b) Availability is limited. Needs pre-planning ☐

c) Availability difficult. Tremendous effort is needed to procure required quantities ☐

4. **Agro-residue being used**

S No.	Type of Agro residue being used	Quantity of agro-residue being used /KWh
1.		
2.		
3.		

5. **Quantities of agro-residue being used**

S. No	Type of agro-residue	Quantity procured per year
1.		
2.		
3.		

6. What are your sources of procurement of agro-residue? (Put ☑ on the source applicable.)

a) Direct from the farmers ☐

b) From the traders ☐

c) Through an agent appointed by you ☐

d) Any other source (specify)……..

7. Prices of agro -residue being used

S.No.	Type of agro-residue	Price Rs/Tonne
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Others (Specify)…….	

8. Distance-wise quantities of agro-residue procured.

	Share of Requirement (%)
a) from a radius of 10 km	…….
b) from a radius of 25 km	…….
c) from a radius of 50 km	…….

9. How do you transport the agro-residue to your plant?

a) Trucks ☐ b) Tempos ☐ c) Bullock carts ☐

d) Tractors ☐ e) Head loads ☐ f) Hand carts ☐

g) Any other (specify) ……

10. What are your terms of payment to the suppliers of agro residue

a) Cash on delivery ☐

b) Advance payment of …….. %

c) On credit of …… days

11. What do you think, are the constraints in using agro-residue

12. What advantage the farmers are deriving from your power plant.

Name of Company …….

Address…….....

Respondent's Name……..... Designation……....

Phone No……..…… Fax ....…….. …

Email ……..

Website……

Date……..Interviewer's Name…….. ..

Annexure 2.03

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format for Sugar Mills

1. Daily cane crushing capacity (TPD) ……

2. Total bagasse generated per day……..…..

3. Do you have cogeneration

Yes ☐ No ☐

If yes: Capacity …….MW

4. Are you planning to have co-generation facility in near future

Yes ☐ No ☐

5. Surplus bagasse available (TPD)……..

6. Consumer shares of your bagasse

a) Paper Mills …….. ……...%

b) Power Plants …… ……..%

c) Other Industries (specify) ……..%

7. Approx. price of your bagasse sold (Rs/Tonne) Ex-Sugar Mill

8. How do the buyer transport the bagasse to their units?

a) Trucks ☐ b) Tempos ☐ c) Bullock carts ☐

d) Tractors ☐ e) Head loads ☐ f) Hand carts ☐

g) Any other (specify) ……

9. What are your terms of payment to buyers of your bagasse

a) Cash on delivery ☐

b) Advance payment of …….. %

c) On credit of …… days

10. Price movement during the past 3 years.

11. Are you procuring other agri-bio mass for your co-generation unit. If yes,

- Which residues
- At what prices
- Procurement radius
- Constraint in availability if any
- Price movements during the past 3 years

12. How your bio-mass procurement is helping the farmers

13. Additional income generated through sales of bagass (average/annum)

Name of Company …….

Address…….....

Respondent's Name……..... Designation……....

Phone No……..…… Fax ....…….. …

Email ……..

Website……

Date……..Interviewer's Name…….. ..

Annexure 2.04

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format for Other Agro-residue based Industries

1. Product mix

S No.	Type of product manufactured	Quantity manufactured
1.		
2.		
3.		

2. Your preference for use of agro-residue (Indicate 1 for top preference in the box.)

a) Bagasse ☐

b) Wheat straw ☐

c) Rice straw ☐

d) Others (Specify)…….

3. How is the availability of agro-residues in your area

a) Available in abundance ☐

b) Availability is limited. Needs pre-planning ☐

c) Availability difficult. Tremendous effort is needed to procure required quantities ☐

4. Agro-residue being used

S No.	Type of Product	Type of agro residue being used	Quantity of agro-residue being used /unit of product
1.			
2.			
3.			

5. Quantities of agro-residue being used

S. No	Type of agro-residue	Quantity procured per year
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Others (Specify)…….	

6. What are your sources of procurement of agro-residue? (Put ☑ on the source applicable.)

a) Direct from the farmers ☐

b) From the traders ☐

c) Through an agent appointed by you ☐

d) Any other source (specify)……..

7. Prices of agro -residue being used

S.No.	Type of agro-residue	Price Rs/Tonne
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Others (Specify)…….	

8. Distance-wise quantities of agro-residue procured.

	Share of Requirement (%)
a) from a radius of 10 km	…….
b) from a radius of 25 km	…….
c) from a radius of 50 km	…….

9. How do you transport the agro-residue to your factory?

a) Trucks ☐ b) Tempos ☐ c) Bullock carts ☐

d) Tractors ☐ e) Head loads ☐ f) Hand carts ☐

g) Any other (specify) ……

10. What are your terms of payment to the suppliers of agro residue

a) Cash on delivery ☐

b) Advance payment of …….. %

c) On credit of …… days

11. What do you think, are the constraints in using agro-residue

12. What advantage the farmers are deriving from your plant.

Name of Company …….

Address…….....

Respondent's Name……..... Designation……....

Phone No……..…… Fax ....…….. …

Email ……..

Website……

Date……..Interviewer's Name…….. ..

Annexure 2.05

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format for Traders of Agro-residues

1. Quantities of agro-residue being traded

S No	Type of agro-residue	Traded Volume (TPD)
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Any other (specify)……	

2. Agro-residue being supplied to

S No.	Type of Agro residue	Type of industry
1.		
2.		
3.		

3. Share of different consumer industries served by you

	Share of your supplies (%)
a) Paper mills	…….
b) Power plants	……
c) Others (specify)	……

4. What are your sources of procurement of agro-residue? (Put ☑ on the source applicable.)

a) Direct from the farmers ☐

b) From other traders ☐

c) Through an agent appointed by you ☐

d) Any other source (specify)……..

5. What are your distances of procurement and supply of agro-residues. Put ☑ where is most relevant.

	Procurement	**Supply**
a) upto 10 km radius	☐	☐
b) upto 25 km radius	☐	☐
c) upto 50 km radius	☐	☐
d) more than 50 km radius	☐	☐

6. Prices of agro -residue being traded

S.No.	**Type of agro-residue**	**Price Rs/Tonne**		
		2007	**2008**	**2009**
1.	Bagasse			
2.	Wheat straw			
3.	Rice straw			
4.	Any other (specify)…….			

9. How do you transport the agro-residue?

a) Trucks ☐ b) Tempos ☐ c) Bullock carts ☐

d) Tractors ☐ e) Head loads ☐ f) Hand carts ☐

g) Any other (specify) ……

10. What are your terms of payment for the suppliers and the buyers of agro residue

Your buyers ☐ **Your suppliers** ☐

a)	Cash on delivery	a)	Cash on delivery
b)	Advance payment of …… %	b)	Advance payment of …….. %
c)	On credit of ……... days	c)	On credit of ……..... days

11. What do you think, are the constraints in availability of agro-residue

12. Monthly how many farmers get benefited out of every tone of bio-mass traded by you.

13. You trade mark up (% of price).

14. Employment generated per tonne of bio-mass

- in transportation
- in loading
- in unloading

Name of Company …….

Address…….....

Respondent's Name……..... Designation……....

Phone No……..…… Fax ....…….. …

Email ……..

Website……

Date……..Interviewer's Name……..

Annexure 2.06

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format for Transporters of Agro-residues

1. Up to what distances you transport agro-residues

S No.	Type of agro residue being transported	Max distance for collection (km)	Max. distance for supply (km)
1.	Bagasse		
2.	Wheat straw		
3.	Rice straw		
4.	Any other (specify).....		

2. Quantities of agro-residue being transported

S No	Type of agro-residue	Transported volumes (TPD)
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Any other (specify) …….	

3. Shares of agro-residue being supplied to

Type of industry	Share of your supply (%)
Paper mills	
Power plants	
Any other (specify)…….	

4. Cost of transportation of agri-residue

S.No.	Type of agro-residue	Cost of transportation Rs/tonne/km
1.	Bagasse	
2.	Wheat straw	
3.	Rice straw	
4.	Any other (specify) …….	

5. How do you transport the agro-residue to the factory?

a) Trucks ☐ b) Tempos ☐ c) Tractors/trolly ☐

d) Any other (specify) ……

9. What do you think, are the constraints in transporting agro-residue

10. Employment generated (Per tonne of bio-mass)

- in transportation
- in loading
- in uploading

Name of transporter ……...

Address…….....

Respondent's Name……..... Designation……..

Phone No……..…… Fax ....……...…..

Email ……

Date……..Interviewer's Name…….. ….

Annexure 2.07

Code No. * ☐☐☐☐

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

Data Format For Farmer House Hold Survey

A. Type of Household	Remarks
1. Name of the Respondent:……	
2. Family type: ☐	
Code 1: Nuclear 2: Joint	
3. No. of household members:	
	Male / **Female**
Working on farm ☐☐ ☐☐	
Working off farm ☐☐ ☐☐	
Non-working ☐☐ ☐☐	
School /college going ☐☐ ☐☐	
Total ☐☐ ☐☐	
Family Income	
4. Annual Farm Income	
Code 1. BPL- Below Rs. 15,000 ☐	
2. Rs. 15,000-30,000	
3. Rs. 30,000-50,000	
4. Above 50,000	
5. Monthly Off-farm Income	
Code 1. Below Rs. 1,000 ☐	
2. Rs. 1,000-3,000	
3. Rs. 3,000-5,000	
4. Rs. 5,000-10,000	
5. Above Rs. 10,000	

* A composite code number to indicate cluster, district, taluka and village location of the sample household

B. Agriculture: Assets

1. Agriculture land owned and operated*

Irrigated: ☐☐☐☐ ha

Un-irrigated:. ☐☐☐☐ ha

Total:. ☐☐☐☐ ha.

Exclude leased out land

2. Leased in land

Irrigated: ☐☐☐☐ ha

Un-irrigated:. ☐☐☐☐ ha

Total:. ☐☐☐☐ ha.

3. Total operated holding

Irrigated: ☐☐☐☐ ha

Un-irrigated:. ☐☐☐☐ ha

Total:. ☐☐☐☐ ha.

4. Livestock owned

	No.
Bullock	☐
Milch cows	☐
buffaloes	☐
Young cattle	☐
Poultry	☐
Other animals (specify)	☐

7. Farm Equipment

Ploughs: ☐ ☐

Manual equipment ☐ ☐

Tractor ☐

Tractor driven or power driven equipment ☐ ☐

Irrigation pumps sets ☐

1. Power 2. Diesel

C. Disposal of Agri-Residues

1. Rabi 2008-09 (Harvested in March/April 2009)

A. Wheat

In case more than one variety is cultivated compile information for each variety separately

Variety cultivated :

Area : ☐☐☐☐ ha.

Yield per ha. : ☐☐☐☐ kg.

Total production ☐☐☐☐ tonnes

Mode of harvesting

1. Manual
2. Combine /mechanical

Yield of wheat straw : …….tonnes

Percent used :

(i) As compost / manure* ☐

(ii) Other domestic or on farm use* ☐

(iii) As fodder* ☐

(iv) Sold* ☐

(v) Burnt in-situ/destroyed ☐

Below 10% - 1
10-25% - 2
25-50% - 3
50-75% - 4
above 75% - 5

☐

(vi) If sold to whom

1. Trader
2. Industry unit at plant site
3. Industry unit agent at farm site
4. Open market

(vii) Price per tonne realized from sale : ……Rs.

☐☐☐☐

(viii) Time point of sale ☐

1. Immediately after harvest
2. Less than a month after harvest
3. More than a month after harvest

(ix) If sold to a trader or industry unit, mode of sale

1. Buyer approached before harvest ☐
2. Buyer approached after harvest
3. Buyer was approached by the farmer

(x) Mode of setting price

1. Was negotiated with buyer before harvest ☐
2. Was negotiated on spot
3. Was fixed by buyer

(xi) In case of direct sale at industry unit site:

a) Was the sale negotiated in advance: Yes ☐ No ☐

b) If yes, was the price fixed at the time of negotiation: Yes ☐ No ☐

c) Did the negotiated price include transport cost : Yes ☐ No ☐

(xii) Do you consider the price realized from sale of stalk / straw reasonable?

Yes ☐

No ☐

(xiii) Could you have realized higher price if you held on to the residue for 2-3 months?

Yes ☐

No ☐

2. Kharif 2008 (Harvested in Nov.-Dec. 2008)

A. Rice

Variety cultivated :

Area : ☐☐☐☐ ha.

Yield per ha. : ☐☐☐☐ kg.

Total production ☐☐☐☐ tonnes

Mode of harvesting

1. Manual
2. Combine /mechanical

Yield of wheat straw : …….tonnes

Percent used :

(i) As compost / manure* ☐

(ii) Other domestic or on farm use* ☐

(iii) As fodder* ☐

(iv) Sold* ☐

(v) Burnt in-situ/destroyed ☐

Below 10% - 1
10-25% - 2
25-50% - 3
50-75% - 4
above 75% - 5

(vi) If sold to whom

5. Trader
6. Industry unit at plant site
7. Industry unit agent at farm site
8. Open market

(vii) Price per tonne realized from sale : ……Rs. ☐☐☐☐

(viii) Time point of sale ☐

1.Immediately after harvest
2.Less than a month after harvest
3.More than a month after harvest

(ix) If sold to a trader or industry unit, mode of sale

1.Buyer approached before harvest ☐
2.Buyer approached after harvest
3.Buyer was approached by the farmer

(x) Mode of setting price ☐

1. Was negotiated with buyer before harvest ☐
2. Was negotiated on spot
3. Was fixed by buyer

(xi) In case of direct sale at industry unit site:

a) Was the sale negotiated in advance: Yes ☐ No ☐

b) If yes, was the price fixed at the time of negotiation: Yes ☐ No ☐

c) Did the negotiated price include transport cost : Yes ☐ No ☐

(xii) Do you consider the price realized from sale of stalk reasonable?

Yes ☐ No ☐

(xiii) Could you have realized higher price if you could have held on to the residue for 2-3 months?

Yes ☐

No ☐

3 a) Apart from rice and wheat stock have you sold any other type of crop residue

Yes ☐

No ☐

b) If yes, specify the type of residue

1. Stalks of Coarse cereals/pulses (jowar, bajra, maize, gram etc.) ☐
2. Sugarcane trash
3. Maize cobs
4. Fodder crop
5. Any other (specify)*

c) To whom sold

1. Trader ☐
2. At factory / plant site
3. in open market

d) Was the income realized from the sale of such residue more/less than that from sale of wheat and rice straw?

More ☐ Less ☐

D. Other Biomass

- **Do industry unit in your area require biomass available in village commons (grasses/fodders) or village forest area as raw material?**

  Yes ☐ No ☐

- **If yeas, can you name such materials:**

  Yes ☐ No ☐

- **Are you aware of anyone in your village having been approached for supply of such materials by an industry unit?**

  Yes ☐ No ☐

E. Impact of Income Increase

- **Has the income derived by you from sale of wheat/price stalk or any other agri-residue to a trader or an industry unit made any substantial difference to your total income?**

  Yes ☐ No ☐

• **If yes how much** **Code : An increase of** ☐ **1. Upto 10%** **2. 10% - 25%** **3. More than 25%** • **If yes, how was a major part of it utilized?** 1. Increased savings ☐ 2. On farm investments 3. Access to education facilities 4. Access to healthy facilities 5. Consumer durables-vehicle, household appliances etc. 6. Expenditure on social occasions	

Checked by:……..…… **Canvassed by:……**

Signature :…….. Signature :…….

Date: …… Date: ……..……

Annexure 2.08

STUDY ON SOCIO-ECONOMIC IMPACT OF AGRO RESIDUE MILLS

PRA Check List

Village……Tehsil……District…….....

State……Date…….Nearest Paper Mill……..…….

Distance from Village……

1. **Total Area (Ha.)……**
2. **No. of Households……..……**
3. **Total Area of the Village …….**
4. **Holding Size……..……..…….No. of Households ……..……..……**
   - **(a) Landless ……..…..**
   - **(b) Less than 1 acre..……..**
   - **(c) 1 to 5 acre ……..…….……..**
   - **(d) 6 to 10 acre…….…….……..**
   - **(e) 11 acres and more ……..……..**
5. **No. of cattle in the village - Cows …….**
   Buffaloes ……..
   Bullocks/Oxen …….
   Other animals (specify) …….
   …….
   …….
6. **Approximate average annual production of :**
   Paddy -
   Wheat -
   Sugarcane -
   Jute -

Kenaf -

Mesta -

Sarkanda -

7. Average annual recovery of :

Wheat Straw -

Rice Straw -

Jute/Kenaf/Mesta Stalk -

8. End use pattern of fodder (% of recovery)

Agri-residue	Compost/ Manure	Fodder	Sold	Wasted
Wheat Straw				
Paddy Straw				
Jute/Kenaf/Mesta Stalk				

9. Appropriate sales to industrial buyers

(Quantity in Tonnes)

	Paddy Straw	Wheat Straw	Jute/Kenaf/Mesta Stalk
Paper Mills			
Power Units			
Other Industrial Units (Pl. name them)			

10. Average price realization last season (Rs./Tonne)

	Paddy Straw	**Wheat Straw**	**Jute/Kenaf/Mesta Stalk**
By Paper Mills			
By Power Units			
By Other Industrial Units (Pl. name them)			

11. Growth in prices during the past 3 years

(Quantity in Tonnes)

	Paddy Straw	**Wheat Straw**	**Jute/Kenaf/Mesta Stalk**
By Paper Mills			
By Power Units			
By Other Industrial Units (Pl. name them)			

12. Additional income being enjoyed by the farmers by selling biomass

By Holding Size……..……Additional Income (Rs./ Household)……

13. How does additional income help the farmers?

(Freedom from debt, improved education, improved standard of living, asset creation etc.)

14. On relation with buyers (Advance payments, credit facility, infrastructure creation etc.)

15. In case there are no buyers, what they do with the residues?

16. Comparative socio-economic advantages/disadvantages for villages with/without paper mill as buyer.

Annexure 2.09

GUIDELINES FOR INTERACTION WITH AGRICULTURE UNIVERSITIES

1. Heads of departments of Post Harvest Management, Economics and Engineering to be contacted.

2. Have any recent studies been undertaken on engineering aspects of harvest technologies to enhance value/quality of agro-residues particularly in respect of rice, wheat, jute and sugarcane.

3. Has any work been done for value addition to the above mentioned agro-residues.

4. Any extension work undertaken to make farmers aware of developing commercial demand for agri-residues.

5. Have any studies been undertaken on economics of agri-waste utilization in industries which use biomass as raw material (particularly bagasse / pith in sugar mills, rice/wheat straw, straw from coarse cereals/pulses, residue in maize, cotton, jute and allied fibre crop etc., grasses like sarkanda / sabai)

6. Discuss main findings of studies mentioned above and obtain available reports where possible.

7. Scope for introduction of industry units in the state which use agro-residues as fuel or raw material listed in item 5.

Respondent's Name……..... Designation……..

Address…….....

Phone No……..…… Fax ....……...…..

Email ……

Date……..Interviewer's Name…….. ….

Annexure-2. 10

List of References

- Statistics compiled by Indian Agro and Recycled Paper Mills Association
- Statistical compilation of Indian Paper Manufacturers Association
- Statistical publications of Indian Sugar Mills Association
- Annual Reports of identified manufacturing units
- Database of CMIE
- CIERs Industrial Data Book
- Statistics available with Indian Trade Promotion Bureau
- Publication and bulletins of paper, sugar and power sectors and other sectors using agro-residues.
- Reports/ publication of Ministry of Industry, Ministry of Commerce and Ministry of Finance, Government of India.
- Annual Report of different Industry Associations.
- Journals, magazines and periodicals published by different government, semi-government, autonomous body, private & public sector organizations/institutions.
- Proceedings of different seminars/conferences including PAPEREX
- Statistic compiled by different paper trader associations
- Information available with Chambers of trade, commerce and industries
- Studies made by UNDP, UNCTAD, World Bank and other International Institutions
- Biomass Resource Atlas, MNES, Govt. of India
- Indian scenario for raw material for Pulp & Paper Industry (1991-92 to 2010-11): Vol. IV. Development Council for Pulp, Paper & Allied Industries (1991-92)
- Paper Industry: Raw Material Scenario (1990-2015): Chairman, DC PPAI. (1990)
- Global Competitiveness of Paper Industry: Jaakko Poyry Consulting (Sep 2002): Commissioned by CPPRI.
- Eleventh Five Year Plan (2007-12): Final Report Vols. III & IV: Planning Commission :90
- Report of the N.P.C. on Availability of Raw Material for Paper Industry (2000)