FINAL REPORT

INDIAN AGRO PAPER MILLS ASSOCIATION
NEW DELHI

A STUDYON OPTIMIZATION OF AGRO RESIDUES BALING AND COLLECTION

Chemprojects Design & Engg. Pvt. Ltd.
17, Panchshila Shopping Centre
New Delhi - 110 017

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CHEM/S/1300/667 30th Sept., 1997.

M/s Indian Agro Paper Mills Association,
1006, Pragati Tower,
26-Rajendra Place,
New Delhi - 110 008.

Kind Attn : Mr. P.G. Mukundan, Secretary General.

Dear Sir,

This has reference to the assignment awarded to us by your coveted organization to study the possibilities of optimizing Agro Residue collection by introducing Baling equipments. We are pleased to submit herewith 4 (four) copies of the Final report and hope you shall find the same in order.

The final report being submitted herewith takes cares of observations/comments of our Draft report submitted to you vide our letter no. CHEM/S/1300/193 dated February 6, 1997. There has been considerable delay in submission of the Final report on account of addition of some primary research and primarily the delay made in receiving offer from few international Baler suppliers which you may be aware of.

The study has been conducted on the basis of both secondary as well as limited primary research conducted in Pant Nagar area of U.P. and Rothak in Haryana. The findings also included the feed back of demonstration given by M/s New Holland Tractors which was also participated by yourself, Shri Parmod Jain, Dr. S.L.Keswani and Dr. A. Panda. The operational expenses aspects have been derived by the discussion during the demonstration and also an in-depth probing of New Holland Tractors' executives and executives of Escorts Claas.

The extended exercise included floating of about six more international enquiries out of which, only New Holland responded with a firm offer. However, M/s Claas of Germany forwarded only technical offer and despite repeated interaction and assurances, commercial offer from them has not yet been received. However, the moment commercial offer from M/s Claas is received by us, it will be analyzed and forwarded to you as an appendix to this report.

The study concludes that Stationary Balers are available only in India and are of no use because of their operational limitations detailed in the report. However, among the mobile Balers, only the rectangular type are found to be suitable for Indian conditions and in case of round Balers, there will be requirement of crane mounted fork lifters which are expensive proposition and operationaly difficult in Indian conditions.

Based on the study's findings, we conclude that IAPMA should procure at least 4 Balers to start with to operate them in Punjab, Haryana and Pant Nagar-Kashipur-Rampur-Moradabad Zone of U.P. on demonstration basis. Once the operational advantages are established, the numbers could be increased in form of purchases by either the paper mills, farmers or the cooperatives at village level. However, since these balers are not available in India, the Association must take up the case with Government for import duty exemption as the efforts proposed to be made is in farmer's, industry's and the national interests. There should be further efforts made to initiate dialogues with Government agencies and NGOs for their active participation in promoting such activities and the banks/financial institutions should also be brought to the scenario for promoting the activities by extending soft loans etc.

Once again, we thank you for your co-operation extended for the successful completion of the study and we shall be pleased to analyze the demonstration findings, once the equipments are procured and despatched to the site as per study's findings.

Thanking you,

Yours sincerely,

DHANANJAY KUMAR.

Encl : as stated above.

CONTENTS

EXECUTIVE SUMMARY

GENERAL

Agro-residues are emerging as one of the most significant alternative raw material for paper industry in India. Being pre-dominantly an agricultural country, agro-residues are abundantly available in India.

There has been found to be a high degree of geographical dispersion of agro-residues in India particularly that of paddy and rice straw - the two major straws included in the study. Hence, all the regions with availability cannot be considered on account of Economic Procurement Zone (EPZ) concept. As a result, the study has endeavoured to locate clusters to study the optimisation of collection and procurement systems.

THE AVAILABILITY SCENARIO

Wheat and rice straws are being used for many other purposes, major of them being thatching, fodder, compost making and other household applications. Taking the above end uses in account, the net availability of wheat and rice straw in India has been estimated as depicted in tables below:

NET AVAILABILITY OF WHEAT STRAW IN INDIA

YEAR	Net Availability of Wheat Straw (Million Tons)
1980 - 81	11.90
1981 - 82	12.30
1982 - 83	14.00
1983 - 84	14.90
1984 - 85	14.50
1985 - 86	15.40
1986 - 87	14.50
1987 - 88	15.10
1988 - 89	17.70
1989 - 90	16.30
1990 - 91	18.00
1991 - 92	18.20
1992 - 93	18.70
1993 - 94	19.60
1994 - 95	21.40
1995 - 96	21.60
1996 - 97	22.40

NET AVAILABILITY OF RICE STRAW IN INDIA (1980-81 TO 1996-97)

Year	Net Availability (Million Tonnes)
1980 - 81	9.90
1981 - 82	9.80
1982 - 83	8.70
1983 - 84	11.10
1984 - 85	11.40
1985 - 86	11.80
1986 - 87	11.20
1987 - 88	10.50
1988 - 89	13.00
1989 - 90	13.60
1990 - 91	13.80
1991 - 92	13.80
1992 - 93	13.30
1993 - 94	14.30
1994 - 95	14.60
1995 - 96	14.60
1996 - 97	15.30

NET SURPLUS IN SHORTLISTED STATES.

Based on EPZ concept and major concentration of cropping pattern the net surplus availability of wheat and rice straw in emerging states are depicted below:

STATE WISE NET AVAILABILITY OF RICE STRAW (DURING 1991-92 - 1994-95)

(Million Tonnes)

State	1991-92	1992-93	1993-94	1994-95
West Bengal	2.21	2.17	3.42	2.28
Uttar Pradesh	1.71	1.78	1.89	1.88
Andhra Pradesh	1.71	1.59	1.71	1.78
Tamil Nadu	1.22	1.22	1.42	1.42
Punjab	1.25	1.29	1.42	1.42
Orissa	1.23	0.99	1.22	1.14
Bihar	0.86	0.65	1.13	1.14
Madhya Pradesh	9.97	1.00	1.10	1.10
Assam	0.57	0.61	0.63	0.61
Karnataka	0.52	0.55	0.57	0.57
Haryana	0.33	0.35	0.38	0.41

STATE WISE NET AVAILABILITY OF WHEAT STRAW (DURING 1991-92 - 1994-95)

(Million Tonnes)

State	1991-92	1992-93	1993-94	1994-95
Uttar Pradesh	6.60	6.50	6.80	7.36
Punjab	4.00	4.00	4.37	4.44
Haryana	2.13	2.32	2.36	2.39
M.P	1.53	1.33	2.21	2.34
Rajasthan	1.47	1.69	1.11	1.84
Bihar	1.14	1.14	1.43	1.40
Gujarat	0.29	0.45	0.30	0.62
Maharashtra	0.20	0.26	0.33	0.36

NET AVAILABILITY OF WHEAT AND RICE STRAW IN SHORTLISTED DISTRICTS.

The districts with a net availability of 100,000 tons of wheat and rice straw each are highlighted below.

NET AVAILABILITY OF WHEAT STRAW IN MAJOR DISTRICTS

'000 Tons

	1995-96	1996-97	1997-98	1998-99	1999-2000
Nainital	117	120	123	125	128
Muzaffarnagar	138	138	137	137	137
Rampur	106	108	109	111	112
Ghaziabad	176	181	187	192	198
Meerut	157	156	155	154	154
Pilibhit	137	143	148	154	159
Moradabad	264	270	277	284	291
Sangrur	633	652	670	689	708
Ludhiana	410	417	425	432	440
Bhatinda	476	495	514	534	553
Amritsar	523	541	560	578	597
Faridkot	518	530	543	555	567
Patiala	492	504	515	527	539
Hissar	436	458	480	502	524
Sirsa	273	287	301	315	329
Karnal	151	138	126	113	100
Jind	211	216	222	227	232
Sonepat	114	113	112	112	111
Sagar	516	497	479	460	441
Jabalpur	597	618	639	660	681
Morena	140	145	151	157	163
Ujjain	97	104	111	118	125

NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS

'000 Tons

	1995-96	1996-97	1997-98	1998-99	1999-2000
Sahjahnapur	98	100	102	104	106
Pilibhit	94	96	98	100	102
Kheri	98	104	110	116	122
Faizabad	88	91	94	97	100
West Dinajpur	177	185	193	201	208
Maldah	108	112	116	121	125
Murshidabad	212	225	238	251	264
Nadia	174	184	193	203	213
24 Pargans (North)	170	178	187	195	204
24 Pargans (South)	181	192	204	215	227
Burdhwan	355	371	387	403	419
Birbhum	194	201	209	217	225
Bankura	206	215	225	234	243
Midnapur west	232	240	248	255	263
Midnapur East	198	207	215	224	232
Patiala	189	194	198	203	207
Sangrur	222	230	239	247	256
Faridkot	99	101	102	103	105
Ferozepur	138	140	142	145	147
Ludhiana	152	154	157	159	161
Bilaspur	176	177	178	179	180
Durg	84	86	88	90	92
Raipur	276	78	280	283	287
West Godavari	220	220	220	221	221
East Godavari	179	180	181	181	182
Krishna	217	221	224	228	232
Guntur	219	226	232	239	246
Nalgonda	189	200	211	221	232
Srikakulam	106	112	117	122	127
Nellore	121	124	128	131	134
Karimnagar	141	149	157	166	174
Thanjavour	278	282	286	290	294
Chengalpattu	169	173	178	183	188
Madurai	106	111	116	122	127

The typical logistic economics involved in bringing these straws to a mill site could be estimated as:

A.	Assumed distance	-	50 Kms.
B.	Straw weight per truck (full size)	-	4 tons (maximum)
C.	Truck charges for 50 Kms.	-	Rs. 1000.00
D.	Loading and unloading expenses (Per Ton)	-	Rs. 200.00
E.	Total expenses on logistics	-	Rs. 1200.00
F.	Logistics expense per ton (for 50 Kms.)	-	Rs. 300.00
G.	Logistics expense	-	Rs. 6.00 Per ton/Per Km.

In addition to the above, a mill has to pay some price to the farmers and the middlemen. All added together, the landed price range between 500/- per ton to as high as Rs. 700/- per ton depending on market forces and the location of the mill, making the utilization viability sometimes questionable. The unbaled nature of the straw is main contributor to the higher landed price. The situation is further deteriorated due to loss of straw in transit by wind blowing and road jerks ranging between 2 to 5% of total straw loaded.

COLLECTION AND PROCUREMENT

There is a solution to collect the straws in baled form .For the purpose, a baling equipment is required to bale the straws. The baling equipments (i.e. baler) could operate in two ways:

i. Stationary and
ii. Mobile

In India, more than 80% of the farmers are using manual harvesting method. Hence, the stationary balers could be the most optimum and desired type of balers in India. However, the harvesting methods in Punjab, Haryana and Uttar Pradesh etc. Shall be requiring Mobile balers since majority of the farmers in these states are utilizing combine harvesting method.

As a result, a combination of stationary as well as mobile balers could be the right choice to meet the objectivity of this study. However, procurement and operation of stationary balers are surrounded with many constraints, discussed in succeeding paragraphs.

STATIONARY BALERS

Internationally, the stationary balers particularly for straw baling, have gone obsolete. Resultantly, a comprehensive hunt for locating supply of stationary balers yielded a limited result. There has been only one firm claiming to supply stationary balers for straw baling i.e. M/s. Kay Iron Works located at Yamuna Nagar of Haryana in India.,

M/s. Kay Iron Works are one of the most reputed suppliers of stationary balers in India. The balers supplied by them are mostly suitable to bale wet bagasse. The company claims to have supplied a baler for wheat straw baling also. In view of the above, a detail discussion about operational aspects was held at their plant at Yamuna Nagar during which it was found that:

1. The baler supplied by them are to be fixed at one place on a concrete structure and cannot be shifted without dismantling.

2. It operates through a 30 H.P. motor which is driven through electricity.

3. The baler is capable of baling straws only upto 50 c.m. in length and anything above 50 c.m. cannot be handled.

4. The baler requires straw with about 30-50% moisture. Since the straws are mostly dry, a moisturising binder is required for the purpose. Presently, molasses are being used as binder.

5. The baler has a speed of 30 RPM producing about 80 to 100 bales per hour with a bale weight of 20 Kgs. each.

6. It requires a maintenance cost of about Rs. 10,000/- per annum.

7. Bale stiching is done manually where two persons are to stich the outcoming bales on both the sides of baler.

8. Straw feeding could be done either through a conveyor or manually which requires about 2-3 labourers.

9. Jute twines could be used.

10. The baler is to be transported at sites in two parts and can be assembled there.

11. Weight of the baler is about 5.5 tons.

12. During operation it creates lot of vibration and hence could not be fixed on a wheel attached cart or trolley.

The above factors suggest that these balers could not achieve the desired objectives due to following reasons:

1. These balers are to be fixed at one place which means that it will hardly take care of a village or two.

2. Application of a binder such as molasses could be suitable if the straws are to be used as a fodder. Use of molasses shall affect the paper quality adversely as the straws are to be used for paper making.

3. Straw sizes vary widely from region to region and crop to crop. The baler's limitation to be capable of handling the straw upto 50 c.m. length only will not be acceptable to the crops yielding straws with larger length.

4. The balers are operated through electricity, which may not be available in most of the villages. Even electrified villages do not get a regular power supply in most of the states

5. The baler operation requires about 5 persons. Considering an average wage of Rs. 50/- per person per day, the wage alone could result to about Rs. 250/- a day for about 16 tons of baled straw at 8 working hours. Hence, the wage alone will be about Rs. 16/- per ton of straw. Even the other operational economics do not allow application of these balers at least for the straws to be used in paper industry.

MOBILE BALERS

The mobile balers hence remain to be the only answer of the problem. In the above scenario, baling of straws is found to be useful on different socio-economic considerations. A mobile baler could be the best answer to overcome the above problem.

The mobile balers are tractor mounted and derives power from the tractor for operation. In developed countries, it normally trails behind the combine harvester however in India the farmers want their field to be vacated within 1 to 2 weeks time to initiate activities for the next crop.

Straw feeding is not required in mobile balers as it collects the straw automatically and bales them in the field. The operational economics are as follows:

1.	Cost of baler	:	Rs. 4.50 lakhs (maximum), imported.
.2.	Interest on equipment (@ 20% per annum)	:	Rs. 0.90 lakhs per annum.
3.	Cost of 45 H.P Tractor (Including accessories and tax etc.	:	Rs. 3.0 lakhs.
4.	Interest on tractor cost	:	Rs. 0.60 lakhs per annum.
5.	Total operational day (baler) in a year	:	120 days
6.	Total operational hours @ 10 hours a day	:	1200 hours in a year.
*7.	Bale produced per hour (round bales)	:	75 bales of 25 Kgs. each
8.	Total bale produced in a year	:	90,000 nos.
9.	Total bale produced in a year (weitage)	:	2250 Tons
10.	Diesel to be consumed per hour.	:	4.5 liters

11.	Diesel to be consumed per year (120 days)	:	5,400 liters
12.	Cost of Diesel	:	Rs. 9/- per liter (averaged)
13.	Total cost on diesel per annum	:	Rs. 48,600/-
14.	Salary of Driver and operator (for 4 months) (@ 2000/- P.M. each	:	Rs. 16,000/-
15.	Repair & maintenance		
	a. Baler @ 5%	:	Rs. 22,500/-
	b. Tractor (Lumpsum)	:	Rs. 5,000/-
16.	Twine @ Rs. 1.33 per bale	:	Rs. 119,700/-
17.	Total operational cost per year. (2)+(4)+(13)+(14)+(15)+(16)	:	Rs. 361,800/-
	Cost per bale	:	Rs. 4.02 or say Rs. 4.0/- per bale of 25 Kgs.
	Cost of baling per ton	:	Rs. 160.80 per ton or say Rs. 161 per ton of straw.

* Depends on density of crop but normally ranges between 75-100 bales per hour.

Note: The calculations are based on rectangular balers.

Source of calculation :

Working of New Holland model of baler at their farm at Palwal - Sohna Road, near New Delhi (Demo photographs enclosed herewith)

In addition to the price to be paid to the farmers the following expenses are to be incurred for transportation of the baled straw:

A.	Assumed distance	-	50 Kms.
B.	Straw weight per truck (full size)	-	8 tons (maximum)
C.	Truck charges for 50 Kms.	-	Rs. 1000.00
D.	Loading & unloading expenses (per truck)	-	Rs. 200.00
E.	Total expenses on logistics support	-	Rs. 1200.00
F.	Logistics expense per ton (for 50 Kms.)	-	Rs. 150.00
G.	Logistics support per ton/K.m.	-	Rs. 3.00

It is evident from above calculations that a paper mill can procure baled straw at 40% cheaper rate than loose one alone on account of transportation. The other benefit of the exercise results in terms of a net saving of more than Rs. 200/- per ton which otherwise could have cost to the farmers in collection of straw. Even if a farmer is offered a price of this extent or even less it will heavily add to his income which otherwise goes just waste.

Density of balers under different shapes vary widely. Round baler have higher density than its counterpart as shown below:

i.	Square/Rectangular bales	-	Density 150-200 Kgs/Cu.m.
ii.	Round Bale	-	Density 300 Kgs/Cu.m.

Round bales have a higher density because it is wrapped during compression and hence the straws are bend and tightly connected with each other. In case of square or rectangular bales, the particles are not in close connection as bulk of the particle is not bend. Normally, a bale chamber size with cross section of 35 c.m. x 46 c.m. delivers a density of 125 Kgs/Cu.m. if it is rectangular or square. However, length of the cross section could be increased upto 120 c.m. depending on volume size of bale desired (maximum upto 50 Kgs.).

The balers producing round bales could have been an optimum proposition as the bale sizes begin with 300 Kgs. each. However, it has its own limitations, particularly in Indian condition.

The round bales used to have a higher volume weight which could not be lifted manually. The lifting of bales shall require a fork lifter which is again crane and tractor mounted. The roads in the villages are too narrow to permit movement of these equipments. Secondly, these additional equipments are capital intensive. Even the round balers have a comparatively longer and higher sizes with large turning radius. The small dimesion of Indian field shall not accomodate a free movement of these equipments and there shall be enormous loss of efficiency on operational grounds.

A typical comparison of operational expenses between rectangular and roudn balers have been provided by one of the leading baler suppliers given in table - 7.01.

OPERATIONAL COST COMPARISON BETWEEN ROUND AND RECTANGULAR BALERS.

S. No.	Factors	Round Balers		Rectangular Balers	
		Rate	Annual Cost (Rs.)	Rate	Annual Cost (Rs.)
1.	Cost of Baler	Rs. 600,000		454,300	
	Interest	20%	120,000	20%	90,860
2.	Cost of tractor 75 up tractor (4 months)	250,000		100,000 (35 H.P.)	
	Interest	20%	50,000		20,000
3.	Operational days	120		120	
4.	Operational hours @ 10/days.	1200		1200	
5.	Bales per hour	7		75	
6.	Bale weight (Kg.)	320		25	
7.	Bales per year	8400		90,000	
8.	Tonnes per year	2688		2250	
9.	Fuel consumption (litres/hour)	4.5		4.5	
10.	Fuel consumption (litres/year)	5400		5400	
11.	Cost of fuel (Rs./litre)	9	48,600	9	48,600
12.	Drivers wage (Rs./month)	2000	8,000	2000	8,000

S. No.	Factors	Round Balers		Rectangular Balers	
		Rate	Annual Cost (Rs.)	Rate	Annual Cost (Rs.)
13.	Repair maintenance (Baler)	5%	30,000	5%	22,715
14.	Repair maintenance (Tractor)	5%	12,500	5%	5,000
15.	Twine @ 800 per pair for 80 baler.	10	84,000	1.33	119,700
16.	Annual running cost		353,100	314,875	
17.	Cost per ton.		131	140	
18.	Crane hire.	@ Rs.400/ hour	480,000		
19.	Cost per ton.	-	178	Nil	Nil
20.	Total cost per ton.	-	309	140	

It is evident from above comparison that there is a substantial difference in the operational cost arising out of two varieties of balers. The operational cost per ton of straw in case of round balers estimates to about Rs. 309 which is only about Rs. 140 in case of the rectangular balers. Besides, the other constraints such as procurement of crane mounted fork lifter and infrastructural hindrances in movement of round balers etc. also precludes use of round balers in India. Hence, the rectangular balers could be the only solution of the problem under study.

BALING EQUIPMENTS

The global enquiry floated has resulted in offers from only three companies, these are:

i. M/s Gallignani S.P.A.
via Molinaccio
10-48026, Russi (RA) Italia

ii. M/s John Dere Export
Steubentrasse 36-42
58140 mannheim
West Germany.

iii. M/s New Holland Tractors (I) Pvt.Ltd.
210,Okhla Inds. Area-III
New Delhi - 110 020.

iv. M/s Class (Only Technical Offer)
Germany

A techno-commercial comparison of the offers have been made as outlined in relevant chapter.

SELECTION OF CLUSTERS FOR BALER DEMONSTRATION

However, there are many other variables clustering around it which preclude the demonstration any where and compels for a careful selection of the clusters where demon-units could be run and generalised later on elsewhere if found successful. The major variables considered are:

1. Holding Sizes of the farmers
2. Availability of large farms
3. Existence of combine harvesting systems
4. At least 1.0 lakh tons of net straw availability within a district which is constituent of a cluster or is a cluster in itself.
5. Farmers positive perception about utilization of modern farm techniques.
6. Availability of industrial avenues for commercial utilization of the straws etc.

The estimation of net availability on district level has been done after discounting the consumption of straws by existing agro based pulp and paper units. The resultant districts which could be selected for demo purpose are as indicated below.

DISTRICT LEVEL CLUSTERS FOR RICE STRAW SUITABLE FOR DEMO OF BALERS *

Districts	State	Net availability (000 Tons)
East & West Midnapore	West Bengal	400.0
Burdwan	- do -	400.3
Bankura	- do -	200.0
Krishna	Andhra Pradesh	200.0
Guntur	- do -	200.0
Nalgonda	- do -	200.0
Raipur	Madhya Pradesh	250.0
*Sangrur	Punjab	200.0

* Only district of Sangrur in Punjab is reported to be using combine harvester. The situation in Andhra and West Bengal is not known. Moradabad-Kashipur-Pant Nagar zone could also be considered, for the purpose.

DISTRICT LEVEL CLUSTERS FOR WHEAT STRAW SUITABLE FOR DEMO OF BALERS

Districts	State	Net availability of Wheat straw (000 Tons)
Jind	Haryana	200.00
Sangrur *	Punjab	500.00
Ludhiana	- do -	400.00
Bhatinda	- do -	450.00
Amritsar	- do -	500.00
Faridkot	- do -	520.00
Patiala	- do -	450.00

* The only district with substantial availability of both rice straw as well as wheat straw.

In light of the above facts it is concluded that the following districts should be selected and arrangement made for demo of balers once the equipments are procured.

FOR WHEAT STRAW

i. Sangrur (Punjab)
ii. Faridkot (Punjab)

FOR RICE STRAW

i. Sangrur (Punjab)
ii. Moradabad - Kashipur - Pant Nagar zone in U.P.*

* Proposal has already been accepted by Prag farms near Pant Nagar in U.P. (Farm size - 500 acres).

SOCIO ECONIMIC RELEVANCE

Introduction of mechanised balers shall have multiple socio economic advantages as outlined in succeeding paragraphs:

As per estimates, India generated a gross availability of 52 million tons of rice straw and about 96 million tons of wheat straw in 1995-96. Out of which, after utilization in other conventional activities, about 22 million tons of wheat straw and 15 million tons of rice straw emerged as net surplus. These net surpluses are either just burnt in the field or used as domestic fuel yielding zero return to the farmers. Certain quantities are also used for compost making which has no visible commercial gain.

Introduction of balers shall facilitate a transportable shape of the straw which in turn shall be procured for industrial use. Even if a bottom line price of Rs. 100/- per ton is assumed to be paid to the farmers, the system shall provide a net price to the extent of Rs. 3700 million to the farmers. The straw thus collected and used in paper making shall produce about 10 million tons of paper yielding a gross price of Rs. 200,000 million at an average price of Rs. 20,000 per ton of paper.

The net surplus straw available in the country, is sufficient to produce about 10 million tons of paper. The same quantity of paper if required to be produced by wood, it will require about 28 million tons of wood. On an average, this volume of tree shall require more than 28,000 acres of land on rotational basis. Hence, the concept shall check deforestation to the extent of 28,000 acres every year.

Introduction and utilization of balers will attract industrial use of straws. Resultantly, the farmers shall recognize commercial vale of straw and hence they will earn an income of about Rs., 3,700 millions from the waste which is just being disposed of at the moment.

Production of paper fetches excise duties and cess. These are one of the major incomes to the exchequers to meet its expenses to run the government as well as undertake infrastructural development and provide services to the citizens. The agro based units are dutied at about 5 to 10% of ex-mill price of paper and a cess of 0.125% on an average. Considering the paper prices averaged at Rs. 20,000 per ton, there will be an excise duty earning of approximately Rs. 20,000 million to the exchequers.

Paper industry normally generates two types of employment.

i. Direct employment.
ii. Indirect employment.

Direct employment could be defined as the personnel involved directly in production, planning and marketing. The indirect employment is generated through ancilliary and auxiliary activities of the units. For example, the people involved in transportation, loading and unloading of raw materials and finished products could be considered as indirect employment. Similarly, the inhabitants engaged in other activities such as Hotels/Restaurants/Dhaba, Grocery, Vegetable business etc. emerging out of the grown township due to existence of unit, benefit through the indirect employment opportunities.

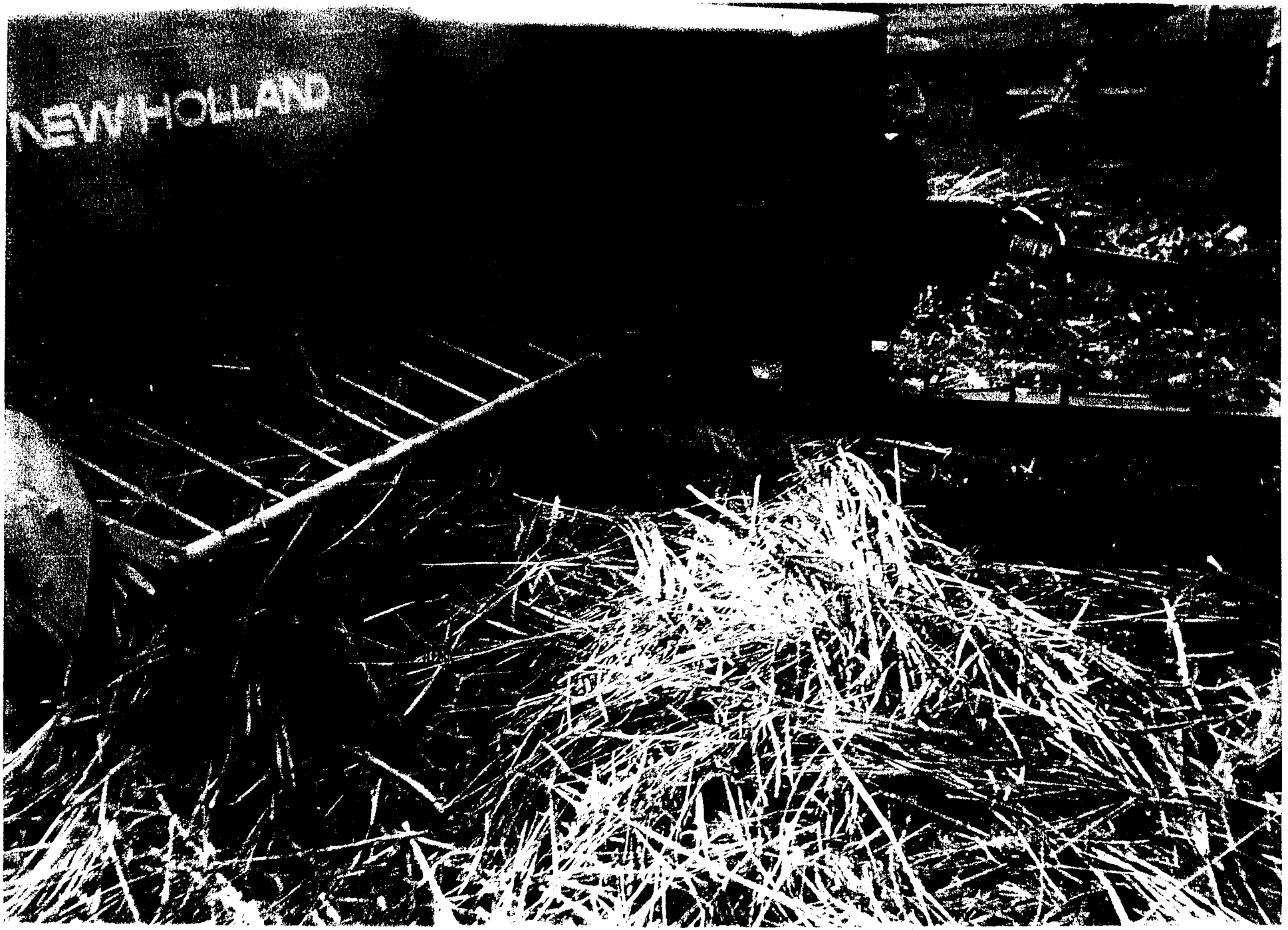
If the entire surplus straws are used for paper making, a capacity of 10 million tons of paper could be realised. The capacity shall generate a direct employment of about 20 million people and indirect employment of about 60 million people, which in turn shall have further multiplier effects in terms of saving, investment and employment generation.

CONCLUSIONS AND RECOMMENDATIONS

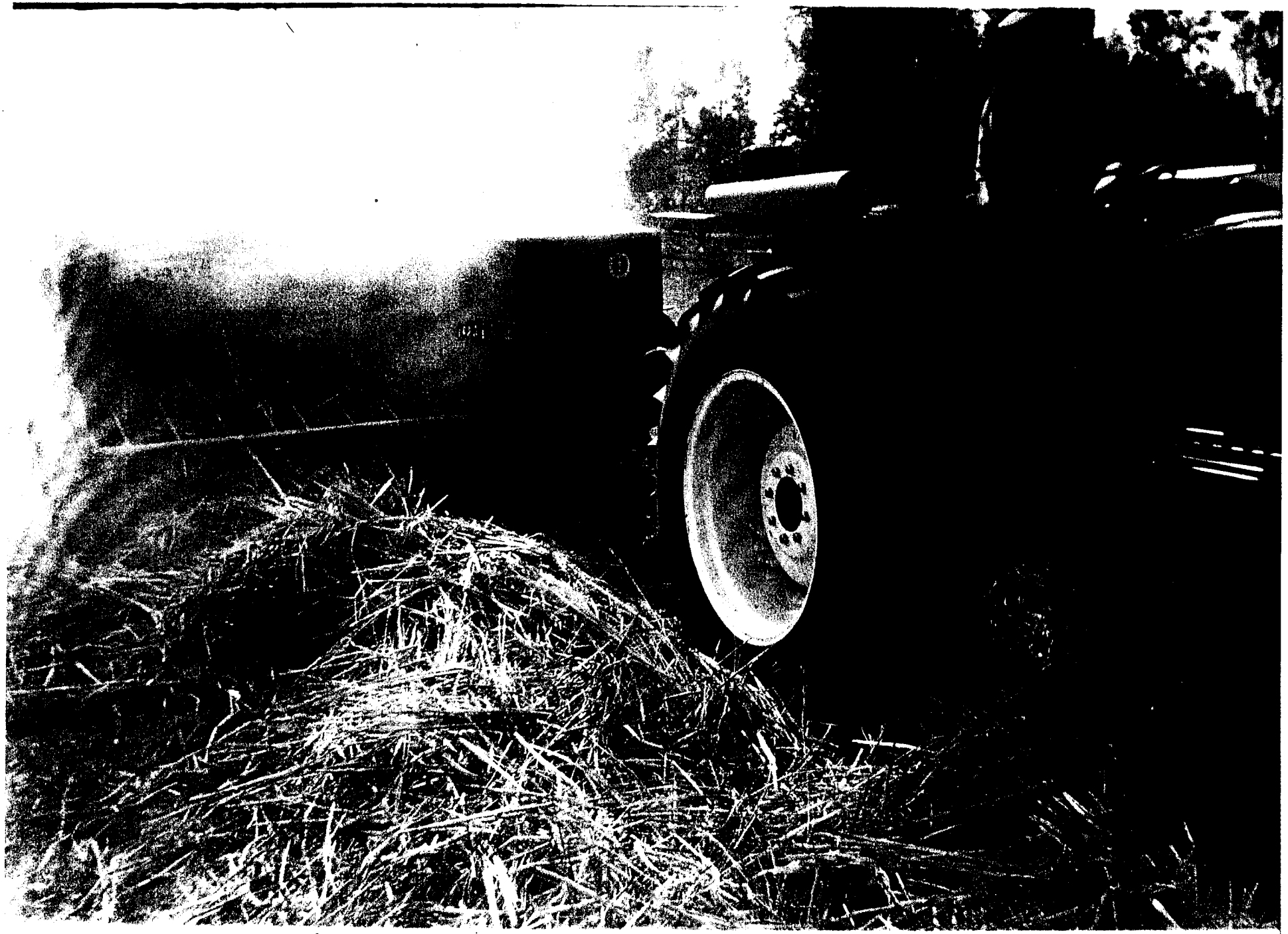
In view of the findings of the study, it could be concluded that the Indian Agro Paper Mills Association should procure mobile balers as per recommendations as demo unit. These balers could be made operational in the selected clusters and its members units should be invited to experience performance of it.

Once the demo balers performances are established, either the paper units should go for purchase of it or the government agencies should popularise them either through co-operative schemes or easy finance schemes. Presently, the import duty alongwith excise and cess on balers imports estimates to about 27 to 28%, with makes the balers more expensive and beyond the reach of the farmers. The exchequers must consider to remove import duty on it and even provide subsidy to the farmers/purchasers under special schemes to popularise use of baler and induce the farmers to earn wealth out of waste.

The promotion of baler uses should be started on village level through Block Development offices or the Tehsils and the Banks should be made a part of the promotion as financer to the equipment. Even these equipments could be procured and operated by the N.G.Os operating in the rural areas. The teamed effort at industry, farmer, government and NGO level shall not only result in protecting the environment but also generate a multiplier effect to the wealth out of waste.



NEW HOLLAND BALER COLLECTING STRAW



TRACTOR MOUNTED BALER IN OPERATION

BALE – READY FOR GROUNDING

BALE JUST BEING GROUNDED

BALE – READY FOR GROUNDING


5 18:24

CHAPTER - 1

INTRODUCTION

1.1 GENERAL

1.1.01 The preservation of natural environment is now an universal slogan and all the countries of the world are joining the crusade to fight against further erosion of the natural ecology. The most important resolve pledged in this endeavor is the preservation of forests and to put an immediate end to the callous felling of the trees.

1.1.02 The availability of the natural wood is getting scarce day by day for the industry in general and paper making in particular. The powerful environmental considerations are further shortening its availability worldwide and the situation has become alarming in India. Hence, the Indian paper makers have gradually shifted their attention to other pulp sources such as recycled fibres and the agro residues etc. Resultantly, about one third of the paper and board capacities are based on agro residues in the country.

1.2 THE BACKGROUND

1.2.01 It is an undisputed fact that the agro residues are emerging as one of the most significant alternative raw material for paper industry particularly in India. Being pre-dominantly an agricultural country, agro residues are abundantly available in India, the productive utilisation of which would enhance the income of the farmers, particularly the rural mass. In some parts of the country, huge quantities of agro-wastes particularly the straws are generally burnt in the farms in lack of effective baling and storing facilities, besides handling and budgetary inconveniences are attached to it.

In India the major Agro residues which are being used for the paper production are :

i. Rice straw
ii. Wheat straw
iii. Bagasse

1.2.02 The above agricultural residues produced across various regions in the country cannot be made available entirely for paper industry. This is mainly because:

1. These Agricultural residues have different uses in rural areas. These are used as fuel, roofing material, fodder, manure etc.

2. All the available surplus quantities cannot be harnessed because of bulky nature of the residues and lack of proper infrastructural facilities for collection, baling, storage and transportation in most of the rural areas.

Thus the availability of Agro residues for paper mills is dependent on one hand the alternative uses of agro residues and on the other infrastructural facilities for collection, baling, storage and transportation.

It will require institutional endeavours to change the utilisation and collection pattern of the Agro residues in India. In order to make a greater availability of Agro residues at an economic delivered cost for paper industry it becomes imperative to introduce the STATE OF ART technology which can provide facilities for collection, baling and storage of agro residues.

1.2.03 At present, in India the availability of Agro residue like wheat straw and Rice straw is restricted due to the existing harvesting and collection systems. However, in the case of bagasse the availability depends on the design features of boiler, operational efficiencies and the fuel preparation methods adopted at the sugar mills.

Most of the bagasse is either being baled in the sugar mills or disposed in loose form. In India, at present two methods of harvesting are existing:-

i. **MANUAL HARVESTING**

In India due to small holding size and lack of capital, manual harvesting is a normal practice. Usually, in manual harvesting, the crop is first cut at a height of above 5 to 10 cm. above the ground level in the case of wheat straw and 20-40 cm in the case of Rice straw. The crops once harvested are brought to a centralized place for threshing. In this process even if the threshing is mechanized the straw disintegrate into small pieces rendering baling difficult or almost impossible, and also operationally not feasible.

ii. **COMBINED HARVESTING**

Combined harvesting started showing its presence in India mostly in large farms and cooperative farms. However, the trend has made its inroad even to an ordinary farmer with relatively smaller holding size. Though the practice has become household phenomenon in western U.P., Punjab and Haryana, it is expanding to Eastern U.P. as well. Hundreds of combined harvesters are available on rental basis to the small farmers on per acre rental basis ranging between Rs. 275 to 400 per acre.

In combined harvesting, the plant is cut at a greater height above the ground level say at about 20 c.m. Resultantly, a significant portion of is left over the ground and are burnt due to economics involved and non-existence of demand. However, if the need be, the combined harvestors could be adjusted to cut the crop at about 5-10 c.m. height above the ground. The combine harvestors drops the long straws in the field, collection of which is uneconomical to the farmers and hence in most of the cases it is burnt in the field.

1.2.04 The lacunae of both of these above methods have made them inefficient to collect the straw in better proportion. A substantial amount of straws collected through manual harvesting not being baled gets lost in transportation. Thus straws of wheat and rice being flexible should be baled for ease of transportation. This will in addition minimise chances of fire hazards and unwanted wastage. Thus there is a need of suitable equipment which could solve the problem of straw left in the field by combine harvesting system and reduces the wastage of straw by manual harvesting system.

The best system which could solve the above problem is combine harvesting and baler systems.

COMBINE HARVESTING WITH BALING SYSTEM

1.2.05 In most of the developed countries, the crop is harvested by combine harvesting systems equipped with inbuilt threshers. The crop is harvested, the grain separated and the straw is left over the field. There is another tractor mounted baler which collects the leftover straw, bale them and put in the trailing trolley by fork lifter. The system of combine harvesting is becoming popular in India, however, the baling practices are still not in vogue. The details of this system are outlined in succeeding paragraphs.

1.2.06 In this system the crop is harvested with the aid of vehicular thresher in such a manner that top of the crop covering grain portion is cut and threshed to separate grain from straw.

1.2.07 Remaining stem of crop which is left over in the fields after cutting top of the crop is first cut in mechanized way and then it is hayed with the help of hay maker in bed from either with same machines having suitable attachment or by a separate machine. Width of hay is kept as per bale width or as per machine design. Being fresh straw, it still contains about 15-35% moisture depending upon the type of straw which is sufficient for baling requirement. This spread straw lying in the fields in the hay form is then baled either in round or rectangular or cylindrical form as per requirement with the help of baling machines. The baling machines have also the provision of conveying and loading the bales in a trolley soon after the bales are formed. The wastage of a straw in the system is very low as compared to the manual system.

1.3 THE STUDY

With the above background, Indian Agro Paper Mill Association desired to conduct a study to optimise the system, identify suppliers of such equipments and monitor functioning of them on experimental basis through demonostration. For the purpose M/s Chemprojects Design & Engg. Pvt. Ltd. , has been assigned to conduct a study for exploring possibilities of this exercise. This study is in compliance with the Association's requirement to assess the exploratory feasibility of the system and study its relevance in Indian context particularly for pulp and paper industry and its socio-economic dimensions.

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CHAPTER - 2

OBJECTIVE & METHODOLOGY

2.1 OBJECTIVE

2.1.01 The study has been carried out with the objectives to:

i. Assess the availability of straw and bagasse for the paper mills at present.
ii. Identify the clusters with Economic Procurement Zone (EPZ) concepts.
iii. Assess the comparative advantages of introducing modern State of Art Technology for the baling of straws.
iv. Identify the Modern Technology based equipments which could enhance the availability of straws and bagasse for the paper mill at an economic delivered cost.
v. Adjudge performances of balers through demonostration of the equipments at suitable sites and explore possibilities to commonize the system on national level with EPZ concept.

METHODOLOGY

2.1.02 The study has been conducted on the basis of secondary as well as limited primary research. The secondary data sources have been utilised to solicit data of mostly macro economic and institutional importance. However, a limited primary research has been conducted to visualize the performance, pro and cons of the system. Another round of primary research is proposed to record the demonostration effects after selection of the desired equipments and will be carried out once the recommended equipments are procured.

2.1.03 SECONDARY RESEARCH

The secondary research has been excerised to solicit informations on total production, consumption and availability of different agro residues in India. Based on these findings the prominent clusters have been identified in order to form the Economic Procurement Zone (EPZ). The major secondary data sources tapped for the purpose are:

i. Agricultural situation in India, published by Ministry of Agriculture, Govt. of India.
ii. India's agricultural sector a compendium of statistics published by, centre for monitoring Indian Economy.
iii. Statistics compiled by central statistical organisations.
iv. Planning commission publication/documents.
v. Publications of indian Sugar Mills association.
vi. Other bulletins, publications, journals etc. Published by different govt. / Semi Govt./ Private/Public Sector Organisations / institutions / Bodies etc.
vii. Bulletins/Research Papers of different agricultural universities.

2.1.04 **PRIMARY RESEARCH**

This research technique has been applied to study the physical performance of baler and combined harvester in G.B. Pant agriculture university in U.P. The farmers in adjoining areas of Pant Nagar and Rohtak have also been contacted to measure their willingness to utilize balers either on rental basis or through ownership.

2.1.05 A further course of primary research has been planned to conduct demonstration of the equipments after procurement and record and analyze the obtained data inputs during demonstration.

2.1.06 This research technique will be applied to identify the clusters with EPZ concept. On the basis of the primary research the potential zones shall be chosen to install the identified equipments for demonstrations. The results shall be derived by a live demonstration of the equipments at the selected sites.

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CHAPTER - 3

AGRO RESIDUE AVAILABILITY - A NATIONAL REVIEW

3.1 GENERAL

3.1.01 India is primarily an agricultural country. Hence, agro residues are available in abundance and the productive utilization of which would protect environment on one hand and enhance the income of the farmers on the other. The availability of agro wastes is based on one hand the production of Agricultural crops and on the other harvesting and collection methods adopted. Further, being based on agricultural crops, it depends upon many man made and natural factors which influence the crop production.

The performance of agricultural sector itself is the first and the most important factor responsible for it. The main factors responsible for performance of agricultural sector are (i) Monsoon (ii) Irrigation (iii) Fertilizer Consumption (iv) Cropping pattern (v) Soil conditions etc. It can be said that availability of agro-wastes is the direct result of multiplier effect of many natural and man-made factors.

The existing study dimension is confined to limited agricultural crops i.e. wheat, rice and sugar cane.

3.1.02 India produces varieties of crops such as rice, wheat, jawar, millets, maize, bazra , pulses, cotton, jute, sugarcane etc. However, the fibrous properties of rice/wheat straw, bagasse etc. are found to be useful in producing quality pulps for paper making.

Before assessing the availability of above mentioned agro residues it will be useful to know about the specific composition of these residues.

3.1.03 **RICE STRAW**

Rice straw is the residual of the paddy crop emerging during the separation of the paddy grain from the crop. The fibre of Rice straws are thin and slender than that of wheat straw and shorter in length. The typical fibre characteristics of rice straw are :

Ash (%)	-	15-18
Lignin (%)	-	12
Hemi cellulose (%)	-	24
Cellulose (%)	-	32
Fibre length (mm)	-	1.1
Fibre dia (microns)	-	16
Length to dia ratio	-	70

Rice straw for its fibre characteristics has been found to be a good fibre for giving bulk to the paper which is one of the most wanted requirement in Indian Paper Industry.

3.1.04 **WHEAT STRAW**

Wheat straw is the residual of the wheat crop emerging during the separation of the wheat grain from crop. The fibres of wheat straw are remarkably uniform and straight with rather thick walls and sharp pointed tapering ends. The composition characteristics of wheat straw fibres are :

Ash (%)	-	7-11
Lignin (%)	-	16-18
Hemi cellulose (%)	-	27-32
Cellulose (%)	-	31-36
Fibre length (mm)	-	1.1
Fibre dia (microns)	-	12
Length to dia ratio	-	91

3.1.05 **BAGASSE**:

Bagasse is the most important of non-conventional raw materials from the point of view of paper production. Bagasse is the fibrous residues left after extraction of juice from sugar cane. The quality of bagasse depends on its fibre content. The fibre content varies between 33-36% in Northern India and 26-30% in Southern India. On an average, bagasse constitutes about 1/3rd of the sugar cane crushed. The mill wet bagasse contains about 48% moisture. The average composition of bone dry bagasse is:-

Ash (%)	-	2-6
Lignin (%)	-	18-21
Hemi cellulose (%)	-	28-30
Cellulose (%)	-	32-41
Length of fibre (mm)	-	1.4
Diameter of fibre (microns)	-	18
Length diameter ratio	-	78

3.2 **AVAILABILITY OF AGRO BASED RAW MATERIALS**

3.2.01 It has been mentioned earlier that total availability of Agro residues mainly depends upon two factors:

i. Production of relevant crops
ii. Harvesting, collection method and utilization pattern.

In order to asses the availability of agro residues it is essential to study both the production of relevant crops as well as the existing end use pattern of straws.

3.2.02 **PRODUCTION OF RELEVANT CROPS**

A. WHEAT

Wheat is a major produced and consumed crop in several states of the country. It has played a very important role in stabilizing the food grains production through Green revolution over the past several decades. The production of wheat crop in the country during the past 15 years is depicted in Table - 3.01.

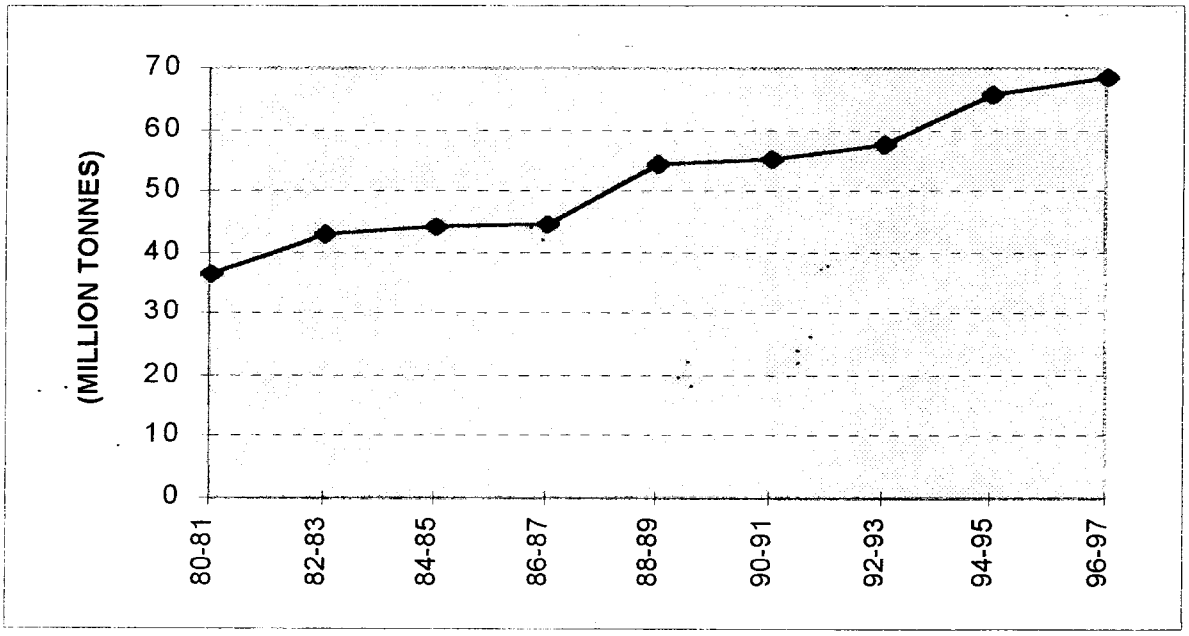
TABLE - 3.01

ALL INDIA PRODUCTION OF WHEAT
(1980-81 TO 1996-97)

YEAR	PRODUCTION (Million Tonnes)
1980 - 81	36.30
1981 - 82	37.40
1982 - 83	42.80
1983 - 84	45.50
1984 - 85	44.10
1985 - 86	47.10
1986 - 87	44.30
1987 - 88	46.20
1988 - 89	54.10
1989 - 90	49.80
1990 - 91	55.10
1991 - 92	55.69
1992 - 93	57.21
1993 - 94	59.84
1994 - 95	65.47
1995 - 96*	65.81
1996 - 97*	68.29

Source: Directorate of Economics & Statistics Department of Agriculture & Cooperation. Govt. of India.
Centre for monitoring Indian Economy.

* Estimated by Chemprojects.



3.2.03 It is evident from Table - 3.01 that inspite of few minor fluctuations between the years the growth in wheat production has been more or less continuous.

STATEWISE PRODUCTION OF WHEAT

3.2.04 Wheat is produced throughout the country. However, the areas of major concentration are states of Haryana, Punjab, Uttar Pradesh, Madhya Pradesh, Gujarat, Bihar, Rajasthan and Maharashtra. State-wise production of wheat (major wheat producing states) is shown in table - 3.02.

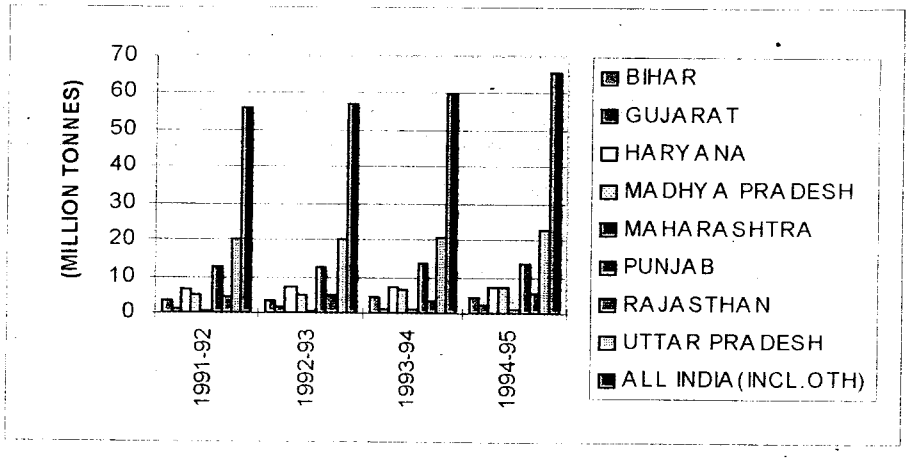
TABLE - 3.02

STATE-WISE WHEAT PRODUCTION
(1991-92 to 1994-95)

(In Million Tons)

	1991-92	1992-93	1993-94	1994-95
Bihar	3.49	3.09	4.36	4.27
Gujarat	0.90	1.36	0.93	1.96
Haryana	6.50	7.08	7.23	7.30
Madhya Pradesh	4.67	4.70	6.76	7.16
Maharashtra	0.62	0.80	1.05	1.11
Punjab	12.29	12.37	13.38	13.54
Rajasthan	4.48	5.15	3.46	5.61
Uttar Pradesh	20.23	19.91	20.82	22.56
All india (Including Others)	55.69	57.21	59.84	65.47

Source: Estimated from agricultural situation in India.



RICE

3.2.05 Rice is the most important Food Crop (nearly 44%) of our total food grain output. Rice is grown on 42 million hectares of land with irrigation coverage of approximately 43%. Table - 3.03 contains the annual production of rice crop in the country during the past 15 years.

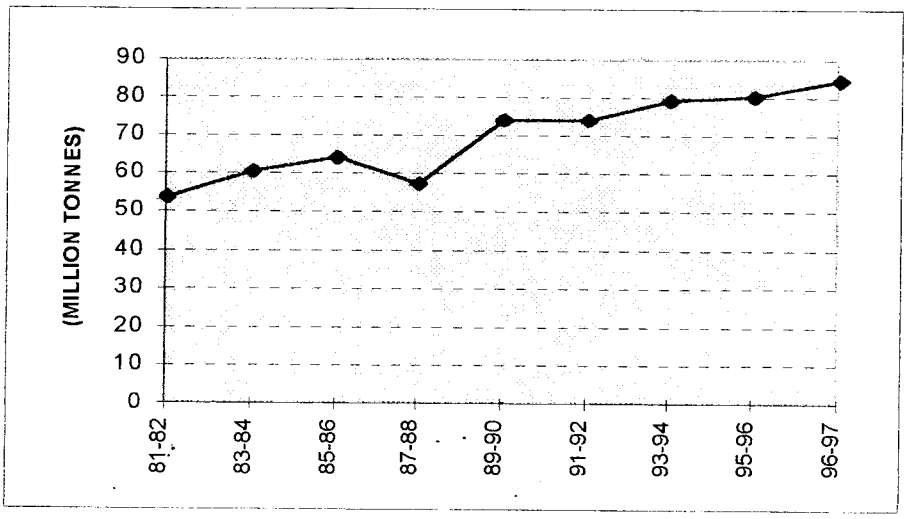
TABLE - 3.03

PRODUCTION OF RICE IN INDIA
(1981-82 TO 1996-97)

YEAR	PRODUCTION (Million Tonnes)
1981 - 82	53.20
1982 - 83	47.10
1983 - 84	60.10
1984 - 85	58.40
1985 - 86	63.80
1986 - 87	60.60
1987 - 88	56.80
1988 - 89	70.50
1989 - 90	73.60
1990 - 91	74.00
1991 - 92	74.00
1992 - 93	72.70
1993 - 94	78.97
1994 - 95	80.30
1995 - 96*	80.00
1996 - 97*	84.00

Source: Directorate of Economics & Statistics Ministry of Agriculture & Cooperation; Govt. of India & Centre for monitoring Indian Economy.

* Estimated by Chemprojects.



3.2.06 The introduction and fast adoption of high yielding varieties of rice crops have been in evidence particularly in the last decade. These varieties produce more of the grain and less of the straws.

STATE WISE PRODUCTION OF RICE

3.2.07 The crop production is spread over the entire country. Table - 3.04 gives the state wise production of Rice (major rice producing states):

TABLE - 3.04

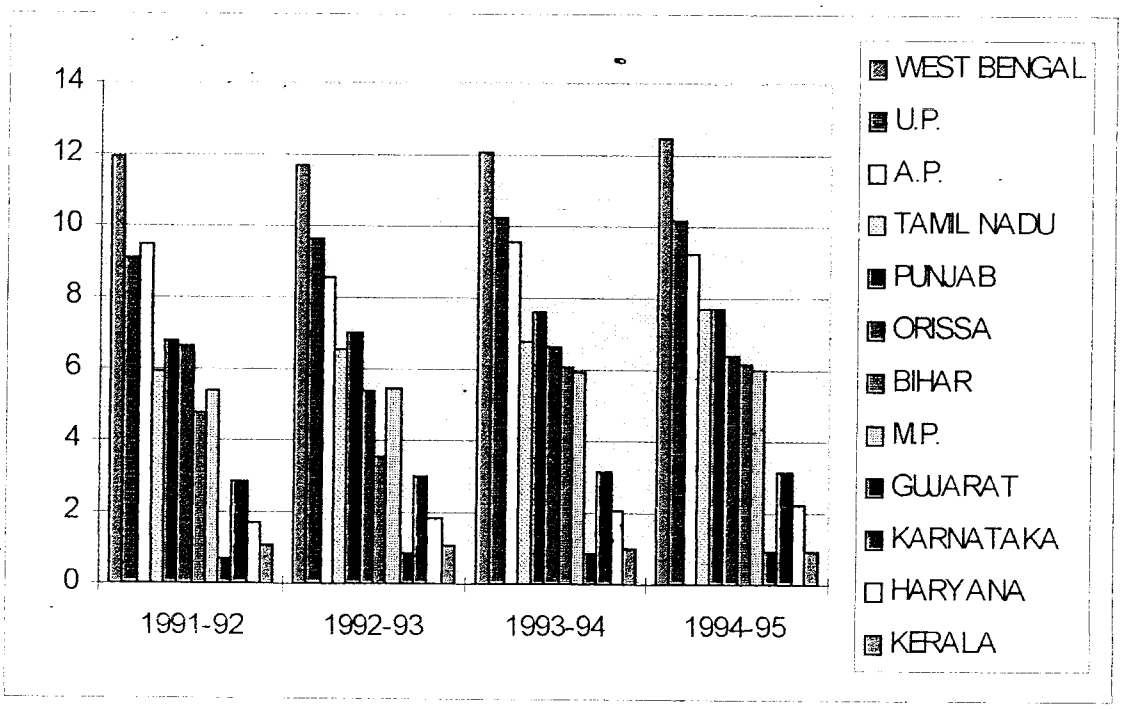
STATE-WISE PRODUCTION OF RICE (1991-92 TO 1994-95)

(Million Tons)

S.No.	State	Production			
		1991-92	1992-93	1993-94	1994-95
1.	Andhra Pradesh	9.464	8.557	9.562	9.221
2.	Bihar	4.753	3.569	6.108	6.168
3.	Gujarat	0.690	0.829	0.838	0.942
4.	Haryana	1.712	1.869	2.057	2.227
5.	Karnataka	2.856	2.967	3.182	3.193
6.	Kerala	1.065	1.084	1.004	0.962
7.	Madhya Pradesh	5.392	5.431	5.963	5.999
8.	Maharashtra	2.100	2.363	2.484	1.537
9.	Orissa	6.659	5.387	6.616	6.353
10.	Punjab	6.755	7.002	7.642	7.703
11.	Tamil Nadu	5.927	6.563	6.749	7.685
12.	Uttar Pradesh	9.104	9.615	10.210	10.123
13.	W.Bengal	11.954	11.732	12.110	12.464

Source: (i) Directorate of Economics & Statistics, Department of agriculture & cooperation.

(ii) Centre for Monitoring Indian Economy



3.2.08 District wise distribution of Rice in major producing state for the past few years is discussed later in this report.

3.2.09 **SUGARCANE**

India is the world's largest producer of sugarcane, currently producing more than 250 million tons. of sugar cane per annum. However only about 45-[illegible]% of the total sugar cane produced goes to the sugar mills, while the balance is used as seed or for the production of gud & khandsari by the village cottage industries and also chewing.

3.2.10 All India production of sugar cane for the year 1980-81 to 1995-96 is shown in Table - 3.05.

TABLE - 3.05

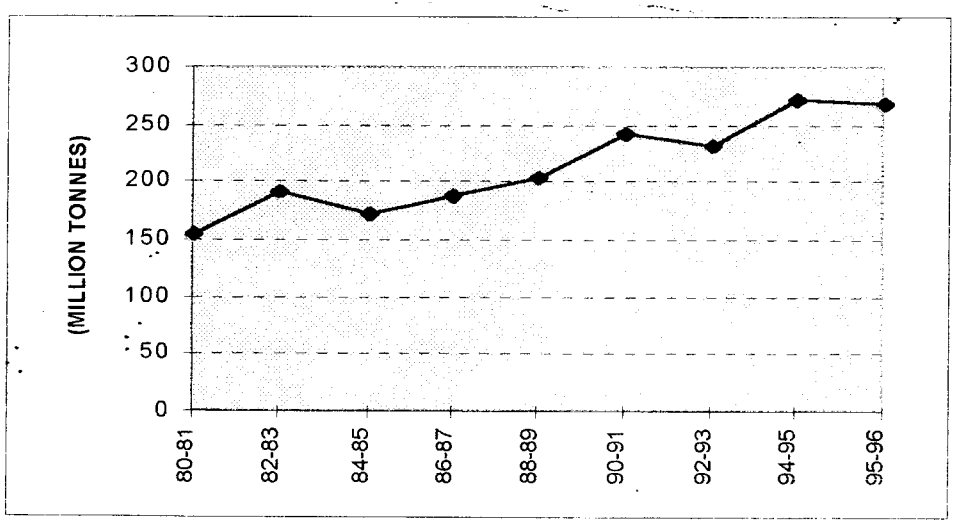
ALL INDIA PRODUCTION OF SUGAR CANE (1980-81 TO 1995-96)

(Million Tons)

Year	Production
1980 - 81	154.20
1981 - 82	186.40
1982 - 83	189.50
1983 - 84	174.10
1984 - 85	170.30
1985 - 86	170.70
1986 - 87	186.10
1987 - 88	196.70
1988 - 89	203.00
1989 - 90	225.60
1990 - 91	241.00
1991 - 92	254.00
1992 - 93	231.00
1993 - 94	229.66
1994 - 95	271.23
1995 - 96*	267.28

Source: CMIE

* Estimated, CMIE



3.2.11 STATE WISE PRODUCTION OF SUGAR CANE

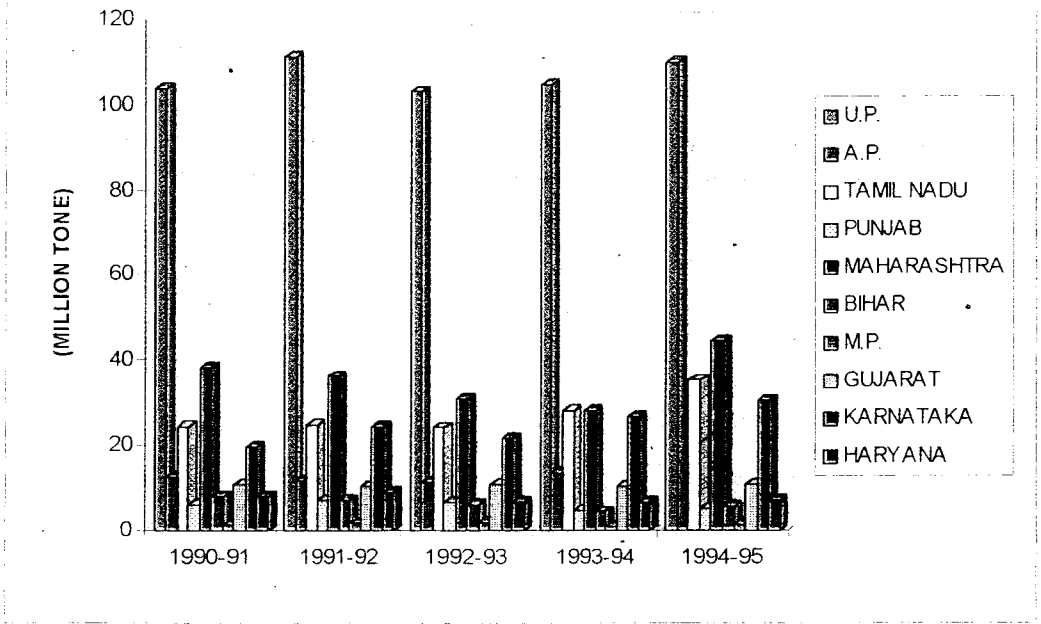
In India, the major state of its concentration are Andhra pradesh, Bihar, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Tamil Nadu and Uttar Pradesh. Table - 3.06 gives the state wise production of sugar cane (major sugar cane producing states):

TABLE - 3.06

STATE WISE PRODUCTION OF SUGAR CANE (1990-91 TO 1994 - 95)

S. No.	State	Production Million Tons				
		1990-91	1991-92	1992-93	1993-94	1994-95
1.	Andhra Pradesh	12.534	11.705	11.329	13.474	15.991
2.	Bihar	7.805	7.076	6.031	4.397	5.667
3.	Gujarat	10.60	10.239	10.872	10.232	10.785
4.	Haryana	7.80	9.00	6.550	6.420	7.010.
5.	Karnataka	19.443	24.117	21.598	26.602	30.325
6.	Madhya Pradesh	1.396	1.646	1.739	1.084	1.511
7.	Maharashtra	38.416	36.186	30.853	27.891	44.260
8.	Punjab	6.00	6.920	6.369	4.710	5.160
9.	Tamil Nadu	24.416	24.886	24.025	27.991	35.236
10.	Uttar Pradesh	103.533	111.098	102.941	104.081	109.907

Source: CMIE



3.3 GROSS AVAILABILITY OF AGRO RESIDUES

3.3.01 The gross availability of Agro residues have been calculated from the recovery of the residues from its parents crops. The basis of the calculation is discussed in succeeding paragraphs.

3.3.02 STRAWS

The recovery and availability of straws from wheat and rice have varied widely from region to region and crop to crop depending upon the variety of crop and harvesting methods adopted. The high yielding varieties of wheat and rice produce more of wheat and rice respectively and less of straws. Similarly the manual harvesting adopted yield more straw than the combine harvesting. However, if combine harvesting method is used with baling system the net recovery in term of suitability to the end-uses is more. This system, however, is still to catch wave in India, excepting in Punjab, Haryana and Western Uttar Pradesh, at least from combine harvestor application point of view.

3.3.03 WHEAT STRAW

The range of straw recovery has been noted to spread from 0.65 tonnes to 2.00 tonnes out of 1 tonne of wheat produced. However, the average recovery norm as reported by the Punjab Agricultural University is to the tune of 1.47 tonnes per tonne of wheat produced.

3.3.04 RICE STRAW

The straw recovery from one tonne of rice crop has varied from 0.3 tonne to 2.5 tonne. However, the average recovery norm as reported by the Punjab Agricultural University is to the tune of 0.65 tonnes per tonne of rice produced.

3.3.05 On the basis of the above findings the gross availability of wheat straw/Rice straw in India in the recent past may be estimated to be of the order as shown in Table - 3.07.

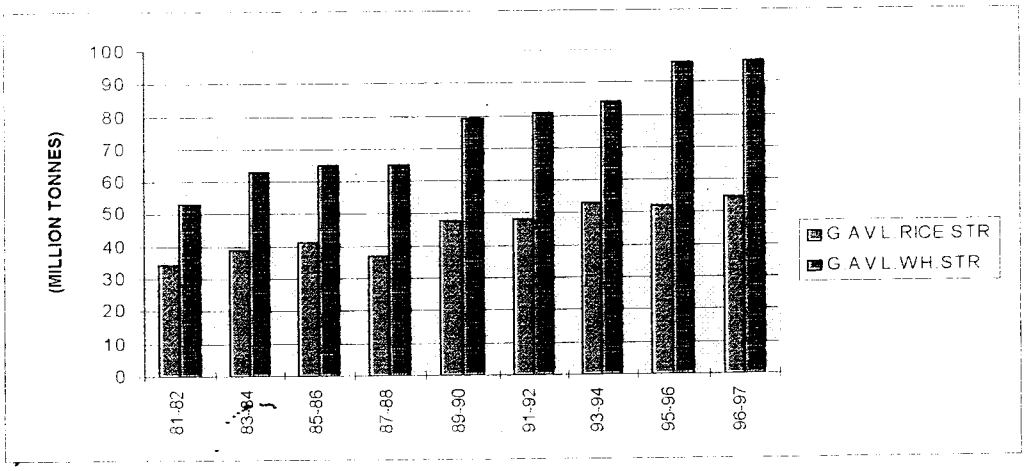
TABLE - 3.07

GROSS AVAILABILITY OF WHEAT STRAW & RICE STRAW IN INDIA (1980-81 TO 95-96)

(Million Tons)

Year	Gross availability of Rice straw	Gross availability of Wheat straw
1981 - 82	34.60	53.40
1982 - 83	30.60	55.00
1983 - 84	39.10	62.90
1984 - 85	40.00	66.90
1985 - 86	41.50	64.80
1986 - 87	39.10	69.20
1987 - 88	36.90	65.10
1988 - 89	45.80	67.90
1989 - 90	47.80	79.50
1990 - 91	48.50	73.20
1991 - 92	48.50	80.80
1992 - 93	46.70	81.70
1993 - 94	53.30	84.10
1994 - 95	52.20	87.90
1995 - 96	52.00	96.20
1996 - 97	54.60	96.70

Source: Chemprojects Estimates



3.3.06 **STATE WISE AVAILABILITY OF STRAW**

In order to establish an Economic Procurement Zone (EPZ), it is necessary to estimate the availability of straw statewise and further district wise. The production of wheat and rice is not uniformly distributed throughout the country. Hence, on quantitative edge basis, only major states have been studied for the purpose. The gross availability of wheat straw in shortlisted states are estimated in table - 3.08.

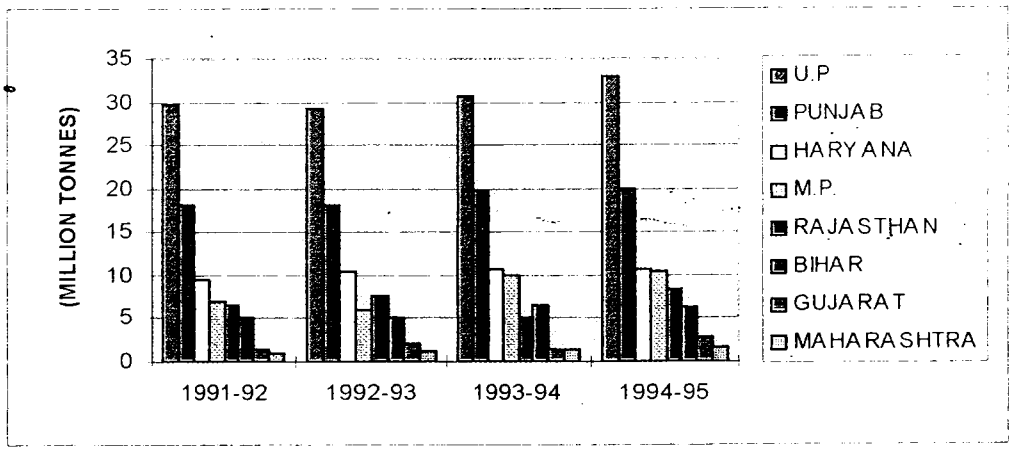
TABLE - 3.08

STATE WISE GROSS AVAILABILITY OF WHEAT STRAW (DURING 1991-92 - 1994-95)

(Million Tons)

State	1991-92	1992-93	1993-94	1994-95
Uttar Pradesh	29.7	29.20	30.6	33.00
Punjab	18.00	18.00	19.60	19.90
Haryana	9.56	10.40	10.60	10.70
M.P	6.86	6.00	9.95	10.50
Rajasthan	6.58	7.57	5.00	8.25
Bihar	5.10	5.00	6.40	6.28
Gujarat	1.30	2.00	1.36	2.80
Maharashtra	0.90	1.17	1.50	1.60

Source: Chemprojects estimates



3.3.07 Table - 3.08 infers that a large amount of wheat straw is generated in the state of Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan and Bihar. However, Gujarat and Maharashtra are also emerging as potential states from the availability point of view of wheat straw.

3.3.08 Similarly, the gross availability of rice straw in major states are depicted in table - 3.09.

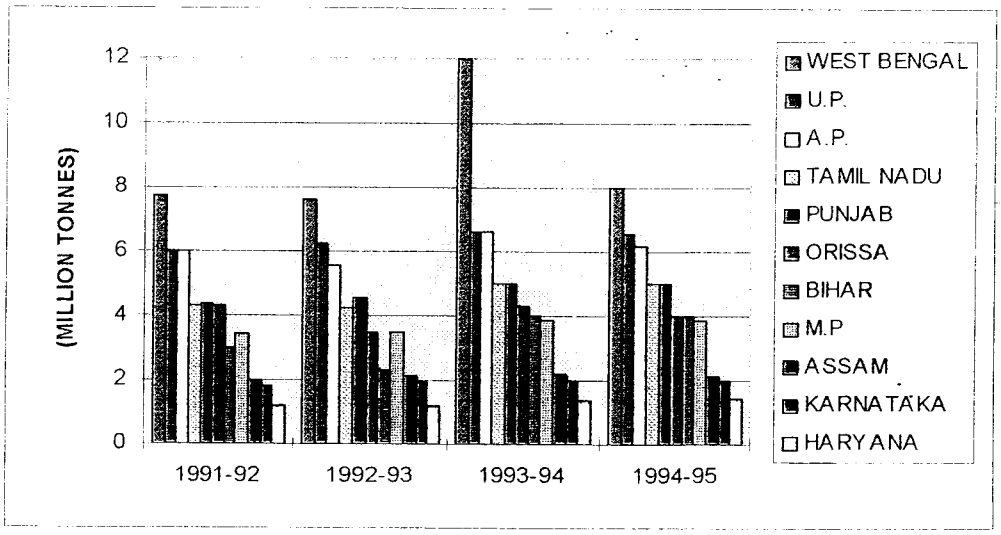
TABLE - 3.09

STATE WISE GROSS AVAILABILITY OF RICE STRAW (DURING 1991-92 - 1994-95)

(Million Tons)

State	1991-92	1992-93	1993-94	1994-95
West Bengal	7.77	7.63	12.00	8.00
Uttar Pradesh	6.00	6.25	6.63	6.58
Andhra Pradesh	6.00	5.56	6.60	6.20
Tamil Nadu	4.29	4.27	5.00	5.00
Punjab	4.39	4.55	4.97	5.00
Orissa	4.33	3.50	4.30	4.00
Bihar	3.00	2.30	3.97	4.00
Madhya Pradesh	3.40	3.53	3.87	3.90
Assam	2.00	2.14	2.20	2.15
Karnataka	1.84	1.93	2.00	2.00
Haryana	1.18	1.21	1.38	1.45

Source: Chemprojects estimates



3. 3.09 Table 3.09 reflects that from Rice straw availability point of view West Bengal, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Punjab and Orissa are the major states in india. However, Bihar, Haryana, Madhya Pradesh and Karnataka could also be considered as substantial rice straw generating states.

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CHAPTER - 4

NET AVAILABILITY SCENARIO

4.01 The net availability of Agro residues for Paper industry depends upon the end use pattern of Agricultural residues produced and recovered. Thus it becomes imperative to study the consumption pattern of these residues.

4.02 CONSUMPTION PATTERN OF AGRO RESIDUES

The entire agricultural residues produced across various regions in the country are not made available for Industrial purposes because :-

i. These agricultural residues have different uses in rural areas. They are used as fuel, roofing materials, fodder, manure etc.

ii. All the available surplus quantities can not be harnessed because of the bulky nature of the residues and lack of proper infrastructural facilities for collection, baling, storage and transportation in most of the rural areas. According to a study conducted by NPC in 1985-86 the utilization pattern of the straws of wheat and rice has been outlined in succeeding paragraphs.

4.03 Exact quantification of straw availability is statistically a difficult job. Different agricultural universities have conducted researches for academic purposes and the results are based on geographical basis. There has been only one study conducted by National Productivity Council acceptable on national basis. As per this study, the end use pattern of residues available are as shown in table - 4.01.

TABLE - 4.01

STATEWISE UTILISATION PATTERN OF PADDY AND WHEAT STRAW

S. No.	States	Percentage Utilisation					
		Sold		Household Consumption		Disposed off	
		Paddy Straw	Wheat Straw	Paddy Straw	Wheat Straw	Paddy Straw	Wheat Straw
1.	Andhra Pradesh	19.6	-	79.3	-	1.1	-
2.	Bihar	22.9	25.4	77.1	74.6	-	-
3.	Gujarat	27.5	6.3	72.5	93.7	-	-
4.	Haryana	9.1	6.0	77.0	94.0	13.9	-
5.	Himachal Pradesh	53.2	27.4	42.6	71.2	4.2	Neg.
6.	Karnataka	11.5	-	86.2	100.0	2.3	
7.	Kerala	49.4	-	50.6	-	-	-
8.	Madhya Pradesh	6.5	10.6	93.5	89.4	-	-
9.	Maharashtra	19.10	21.3	81.10	78.7	-	-
10.	Orissa	18.4	79.2	84.6	20.8	-	-
11.	Punjab	39.0	31.2	36.2	68.8	24.5	-
12.	Rajasthan	-	24.9	100.0	75.1	-	-
13.	Tamil Nadu	35.9	-	63.9	-	0.2	-
14.	Uttar Pradesh	41.3	21.4	58.7	-	-	-
15.	West Bengal	25.8	9.2	74.2	90.8	-	-
16.	All India	25.9	22.3	71.5	77.7	2.6	Neg.

Source : National Productivity Council Study.

4.04 According to the study about 71.5% of paddy straw produced in the country was used by the house hold themselves for various purposes such as fuel, animal feed, construction materials etc. About 25.95 percent were sold either to other household or trading agents who in turn sold it to industrial units. About 2.6 percent of paddy straw is disposed off as waste. Most significantly, a major part of the production is disposed off as waste in the states of Punjab and Haryana. The farmers from these regions did not prefer Paddy straw as a feed for Cattles except when there was an acute shortage of other crop residues. Thus according to NPC study that if not disposed as waste about 28% of Rice straw could be made available for industrial purposes.

4.05 According to the NPC study the wheat straw is the main source of cattle feed particularly in Northern India. About 77.7 percent of wheat straw available in rural areas was found to be used by the household themselves for different purposes. Only 22.3 percent of the straws are left for Industrial purposes.

These surplus residues of wheat and rice if not received and consumed by the industry just go in vain.

4.06 **NET AVAILABILITY OF WHEAT AND RICE STRAW FOR PAPER INDUSTRY.**

The factors worked out by National Productivity Council for arriving at the figure of net availability of wheat and rice straw on national basis may be considered as available to any industry as raw material. On the basis of the following formulas the net availability of wheat and rice straw in India could be shown as depicted in Table - 4.02 and Table - 4.03 respectively.

Formula for Wheat Straw

W = X. X1. X2

Where,

W = Net availability of wheat straw per year.
X = Total production of wheat grain per year.
X1 = 147% Representing ratio of straw to the wheat production.
X2 = Ratio of wheat straw available for use as raw materials for paper industry after its other uses (22.3% of total availability).

Formula for Rice straw.

R = S X S1 X S2 Where,
R = Net availability of rice straw per year.
S = Total production of rice grain per year.
S1 = 65% Representing ratio of straw to the rice production.
S2 = Ratio of wheat straw available for use as raw materials for paper industry after its other uses (28% of total availability).

TABLE - 4.02

NET AVAILABILITY OF WHEAT STRAW IN INDIA

YEAR	Net Availability of Wheat Straw (Million Tons)
1980 - 81	11.90
1981 - 82	12.30
1982 - 83	14.00
1983 - 84	14.90
1984 - 85	14.50
1985 - 86	15.40
1986 - 87	14.50
1987 - 88	15.10
1988 - 89	17.70
1989 - 90	16.30
1990 - 91	18.00
1991 - 92	18.20
1992 - 93	18.70
1993 - 94	19.60
1994 - 95	21.40
1995 - 96	21.60
1996 - 97	22.40

Source : Chemprojects Estimates.

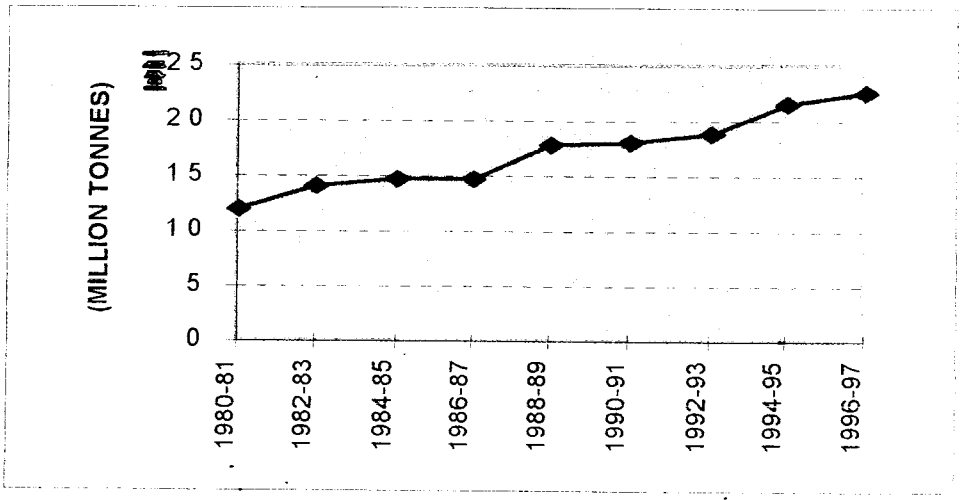


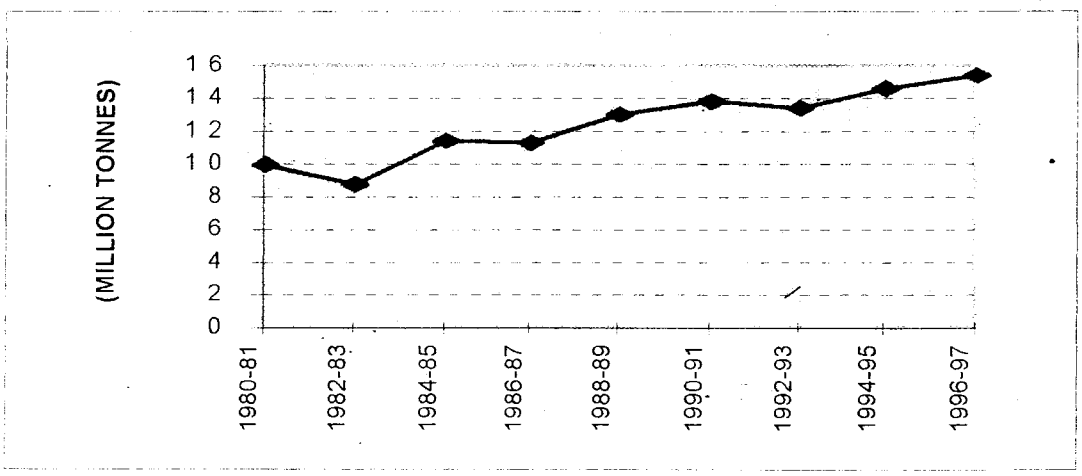
TABLE - 4.03

NET AVAILABILITY OF RICE STRAW IN INDIA (1980-81 TO 1996-97)

(Million Tons)

Year	Net Availability
1980 - 81	9.90
1981 - 82	9.80
1982 - 83	8.70
1983 - 84	11.10
1984 - 85	11.40
1985 - 86	11.80
1986 - 87	11.20
1987 - 88	10.50
1988 - 89	13.00
1989 - 90	13.60
1990 - 91	13.80
1991 - 92	13.80
1992 - 93	13.30
1993 - 94	14.30
1994 - 95	14.60
1995 - 96	14.60
1996 - 97	15.30

Source : Chemprojects Estimates.



407 The above surplus of about 15.30 million tons of straws mostly go for the paper industry, mushroom, compost making etc. and if not utilised just go in vain. Here, the net availability means that the surplus left after its other utilization but excluding consumption by the paper industry in that zone.

4.08 Based on the NPC norms, the net availability of rice straw and wheat straw in major states have been estimated in table 4.04 and 4.05 respectively.

STATE WISE NET AVAILABILITY OF AGRO RESIDUES

TABLE - 4.04

STATE WISE NET AVAILABILITY OF RICE STRAW (DURING 1991-92 - 1994-95)

(Million Tons)

State	1991-92	1992-93	1993-94	1994-95
West Bengal	2.21	2.17	3.42	2.28
Uttar Pradesh	1.71	1.78	1.89	1.88
Andhra Pradesh	1.71	1.59	1.71	1.78
Tamil Nadu	1.22	1.22	1.42	1.42
Punjab	1.25	1.29	1.42	1.42
Orissa	1.23	0.99	1.22	1.14
Bihar	0.86	0.65	1.13	1.14
Madhya Pradesh	9.97	1.00	1.10	1.10
Assam	0.57	0.61	0.63	0.61
Karnataka	0.52	0.55	0.57	0.57
Haryana	0.33	0.35	0.38	0.41

Source : Chemprojects Estimates.

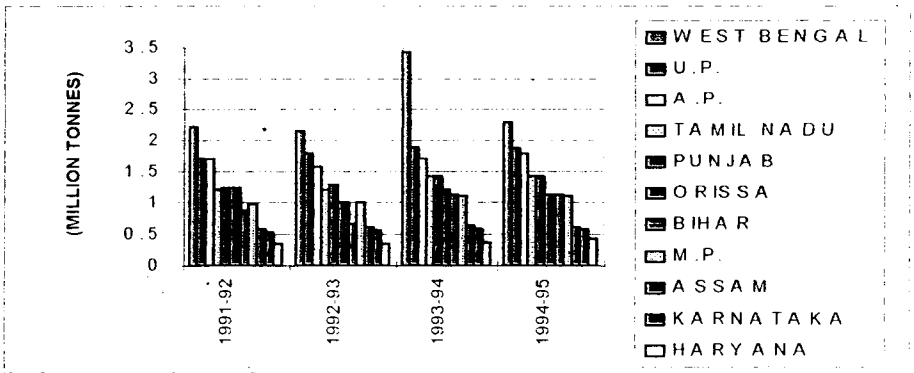


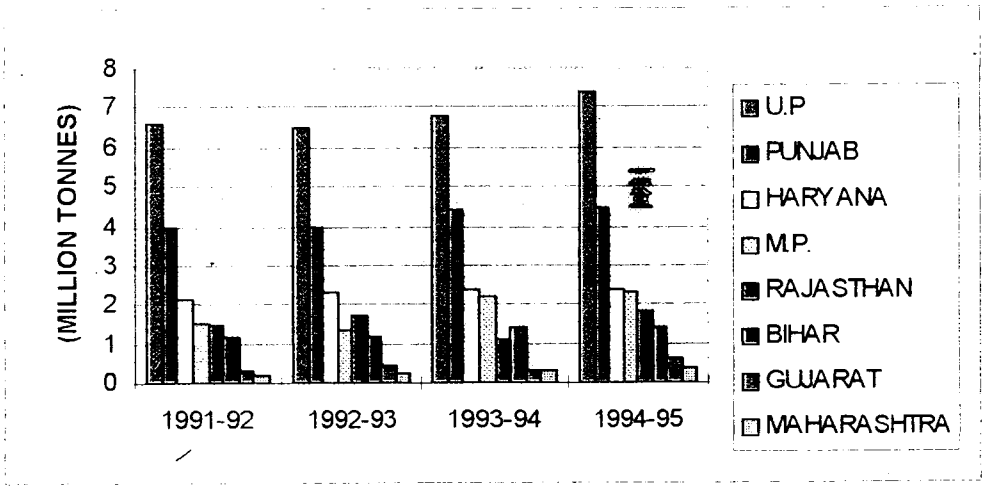
TABLE 4.05

STATE WISE NET AVAILABILITY OF WHEAT STRAW (DURING 1991-92 - 1994-95)

(Million Tons)

State	1991-92	1992-93	1993-94	1994-95
Uttar Pradesh	6.60	6.50	6.80	7.36
Punjab	4.00	4.00	4.37	4.44
Haryana	2.13	2.32	2.36	2.39
M.P	1.53	1.33	2.21	2.34
Rajasthan	1.47	1.69	1.11	1.84
Bihar	1.14	1.14	1.43	1.40
Gujarat	0.29	0.45	0.30	0.62
Maharashtra	0.20	0.26	0.33	0.36

Source : Chemprojects estimates.



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CHAPTER - 5

DISTRICT-WISE NET AVAILABILITY SCENARIO

5.1 GENERAL

51.01 The straw availability in India has shown a high degree of dispersion in terms of its quantitative appearance. Hence, the net available quantities, are not economically procurable in order to make them available for industrial purposes. The situation arises because of small and dispersed nature of the availability. The problem has been handled here by stepping down from national to state and state to district level in order to identify the availability and their bottom-line quantitative edge facilitating supplies to the paper mills on least logistics hindrances and adverse procurement economics.

5.1.02 Efforts have been made to identify the districts within already selected states having a bottomline net availability of around 100,000 tons of straws. The districts showing a lesser availability has been removed from the study dimension. These districts after shortlisting have been studied from net straw availability point of view. The excercise has been carried out for each individual shortlisted states. The net availability scenario in each district has also been projected in order to acquire the future outlook. The state-wise scenario is discussed in succeeding paragraphs.

THE NET STRAW AVAILABILITY SCENARIO IN SELECTED DISTRICTS.

5.2 WHEAT STRAW

UTTAR PRADESH.

5.2.01 Uttar Pradesh is the state with largest production and surplus of wheat straw. Barring the hilly districts of Uttar Kashi, Almorah, Dehradun, Garhwal, Tehri Garhwal, Chamoli and Pithoragarh, it is available throughout the states. Few of the districts are producing even more than 2 lakh tonnes of wheat straw.

Western U.P. has more of wheat straw than its Counterpart, the eastern U.P. The district wise distribution in state of U.P. is depicted in table - 5.01.

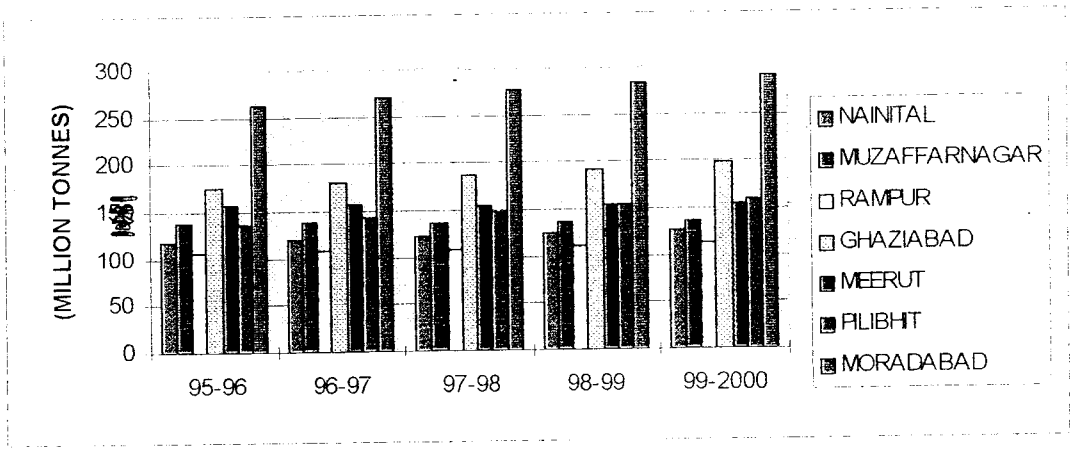
TABLE - 5.01

PROJECTED NET AVAILABILITY OF WHEAT STRAW IN MAJOR DISTRICTS OF U.P

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Nainital	117	120	123	125	128
2. Muzaffarnagar	138	138	137	137	137
3. Rampur	106	108	109	111	112
4. Ghaziabad	176	181	187	192	198
5. Meerut	157	156	155	154	154
6. Pilibhit	137	143	148	154	159
7. Moradabad	264	270	277	284	291

Source : Chemprojects Estimates.



5.2.02 **PUNJAB**

Punjab emerges as the second largest state for the production of wheat straw. The district wise distribution of straws in the state of Punjab has been given in Table - 5.02

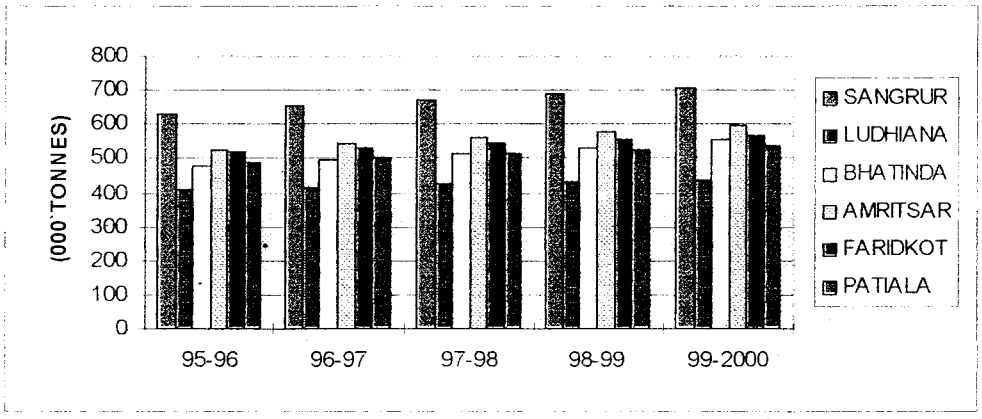
TABLE - 5.02

PROJECTED NET AVAILABILITY OF WHEAT STRAW IN MAJOR DISTRICTS OF PUNJAB

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Sangrur	633	652	670	689	708
2. Ludhiana	410	417	425	432	440
3. Bhatinda	476	495	514	534	553
4. Amritsar	523	541	560	578	597
5. Faridkot	518	530	543	555	567
6. Patiala	492	504	515	527	539

Source : Chemprojects Estimates.



HARYANA

5.2.03 Another potential state for wheat straw availability is Haryana. Though smaller in size, Haryana is one of the most advanced state in agricultural sector. Hissar is the district with largest production of wheat straw where during 1995-96 the net availability of wheat straw is estimated to be over 4 lakhs tonnes. The figures for the districts which have net availability of more than 1 lakh tonne of wheat straw has been given in the table - 5.03.

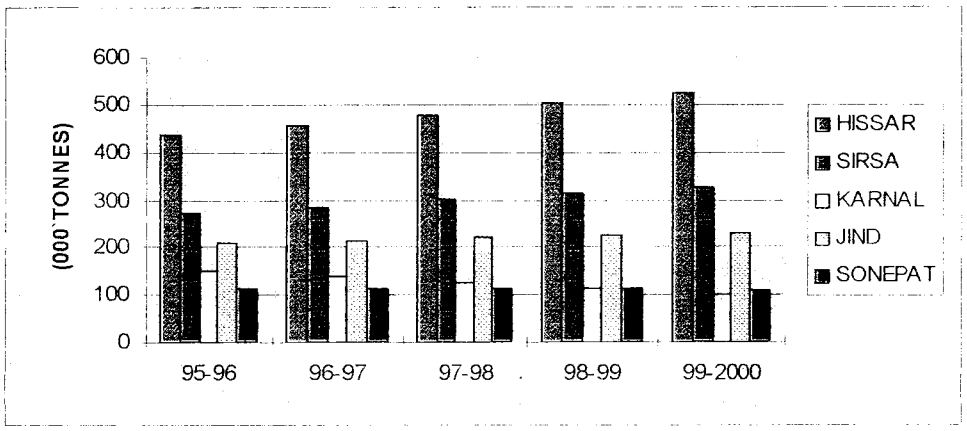
TABLE - 5.03

PROJECTED NET WHEAT STRAW AVAILABILITY IN MAJOR DISTRICTS OF HARYANA

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Hissar	436	458	480	502	524
2. Sirsa	273	287	301	315	329
3. Karnal	151	138	126	113	100
4. Jind	211	216	222	227	232
5. Sonepat	114	113	112	112	111

Source : Chemprojects Estimates.



5.2.04 **MADHYA PRADESH**

Wheat straw is produced throughout the state of Madhya Pradesh. The Districts in position to yield a surplus of more than 1.0 lakh tons are depicted in table - 5.04.

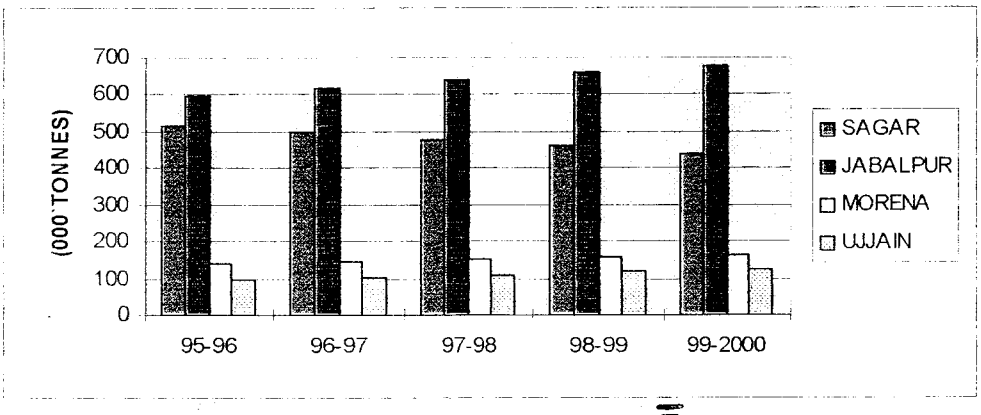
TABLE - 5.04

PROJECTED NET WHEAT STRAW AVAILABILITY IN MAJOR DISTRICTS OF M.P.

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Sagar	516	497	479	460	441
2. Jabalpur	597	618	639	660	681
3. Morena	140	145	151	157	163
4. Ujjain	97	104	111	118	125

Source : Chemprojects Estimates.



5.2.05 **BIHAR**

The states of Bihar appears to be a promising state in respect of wheat straw but not a single district has availability of straw more than One lakh tonnes.

5.2.06 **MAHARASHTRA**

Maharashtra, appears to be a poor state from the point of view of wheat straw availability. The only district i.e. Ahmednagar is able to produce more than One lakh thirty thousand tonnes of it per annum.

5.2.07 **GUJARAT**

Excepting the districts of Kheda and Mehsana no other districts in Gujarat could be declared as district with adequate production. However, even these districts do not harbour large net surplus availability and hence are excluded from the list of potential districts.

5.3 RICE STRAW

5.3.01 Rice straw is available throughout India. As per 1994-95 statistics the states of West Bengal and Uttar Pradesh have been the largest rice straw generating states of the country. West Bengal topped the list with a gross generation of 8.0 Million tonnes of Paddy straw followed by U.P. which had a gross availability of 6.58 Million tonne. The other major state from Rice straw availability point of view are Punjab, Haryana, Bihar, Orissa, Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra.

5.3.02 **UTTAR PRADESH**

The hilly districts of Uttar Pradesh namely Almorah, Pithoragarh, Tehri Garhwal, Uttarkashi, Garhwal, chamoli etc. have a low production of rice straw. The other parts, though scattered in a large geographical area, generate a reasonably high quantity of Rice straw. The scenario in major districts are shown in table - 5.05.

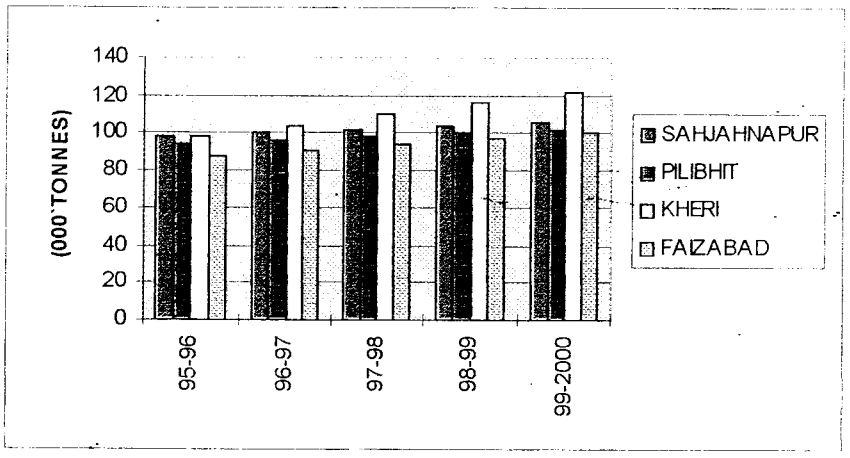
TABLE - 5.05

PROJECTED NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS OF U.P

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Sahjahnapur	98	100	102	104	106
2. Pilibhit	94	96	98	100	102
3. Kheri	98	104	110	116	122
4. Faizabad	88	91	94	97	100

Source : Chemprojects Estiamate.



In Uttar Pradesh the production of Rice is highly scattered and hence the availability of straw. However, the straws in western part where combined harvesting method is in vogue, are just burnt in the field by the farmers on collection economics grounds.

5.3.03 **WEST BENGAL**

In West Bengal, barring the hill district of Darjeeling, all the other districts are in favourable position on rice straw generation front. Most of the districts have the surplus of over hundred thousand tons of rice straw. The scenario is reflected in table 5.06.

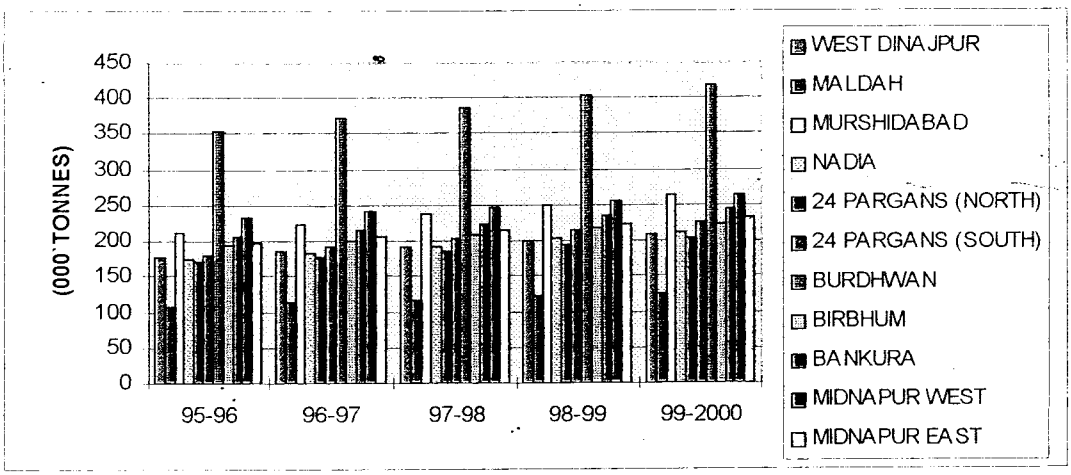
TABLE - 5.06

PROJECTED NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS OF WEST BENGAL

('000 Tons)

[illegible]	1995-96	1996-97	1997-98	1998-99	1999-2000
1. West Dinajpur	177	185	193	201	208
2. Maldah	108	112	116	121	125
3. Murshidabad	212	225	238	251	264
4. Nadia	174	184	193	203	213
5. 24 Pargans (North)	170	178	187	195	204
6. 24 Pargans (South)	181	192	204	215	227
7. Burdhwan	355	371	387	403	419
8. Birbhum	194	201	209	217	225
9. Bankura	206	215	225	234	243
10. Midnapur west	232	240	248	255	263
11. Midnapur East	198	207	215	224	232

Source: Chemprojects Estimates.



5.3.04 **PUNJAB**

There is abundance of rice straw available in Punjab. Most of the districts have the net surplus of more than 100,000 tonnes of rice straw. The estimated figures for the selected districts of Punjab are depicted in table - 5.07

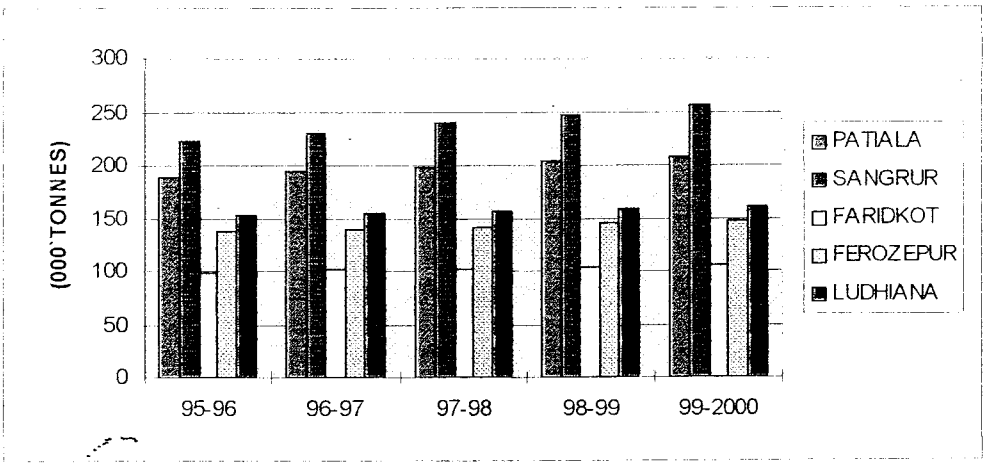
TABLE - 5.07

PROJECTED NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS OF PUNJAB

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Patiala	189	194	198	203	207
2. Sangrur	222	230	239	247	256
3. Faridkot	99	101	102	103	105
4. Ferozepur	138	140	142	145	147
5. Ludhiana	152	154	157	159	161

Source : Chemprojects Estimates.



5.3.05 **MADHYA PRADESH**

Madhya Pradesh had an estimated rice straw surplus of 3.9 Million Tonnes during 1994-95. The major surplus districts are Durg, Raipur and Bilaspur. The estimated figure for the above mentioned districts have been depicted in table - 5.08.

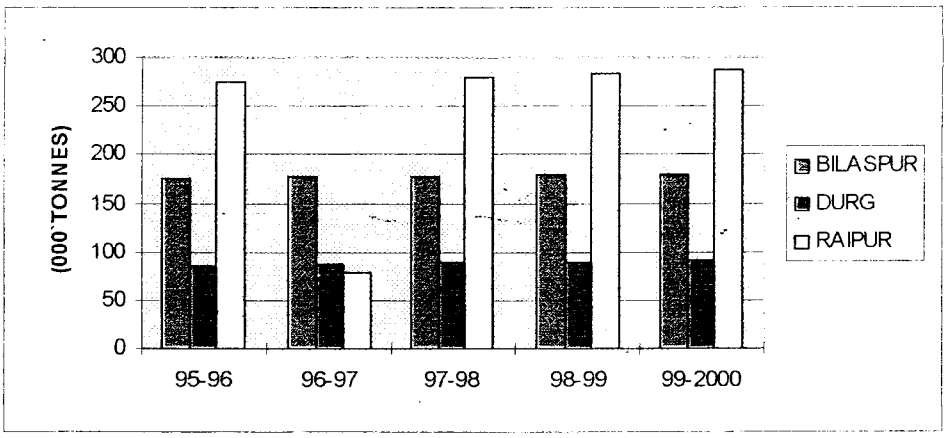
TABLE - 5.08

PROJECTED NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS OF M.P.

('000 Tons)

Districts	1995-96	1996-97	1997-98	1998-99	1999-2000
1. Bilaspur	176	177	178	179	180
2. Durg	84	86	88	90	92
3. Raipur	276	278	280	283	287

Source : Chemprojects Estimates.



5.3.06 **ANDHRA PRADESH**

Rice and thus rice straw is produced in all the four states of Southern India. The total generation of straw in Andhra Pradesh during 1994-95 was 6.2 Million Tons.

The districts which had maximum availability of Rice straw during 1995-96 could be considered as potential districts from net availability point of view are depicted in table - 5.09.

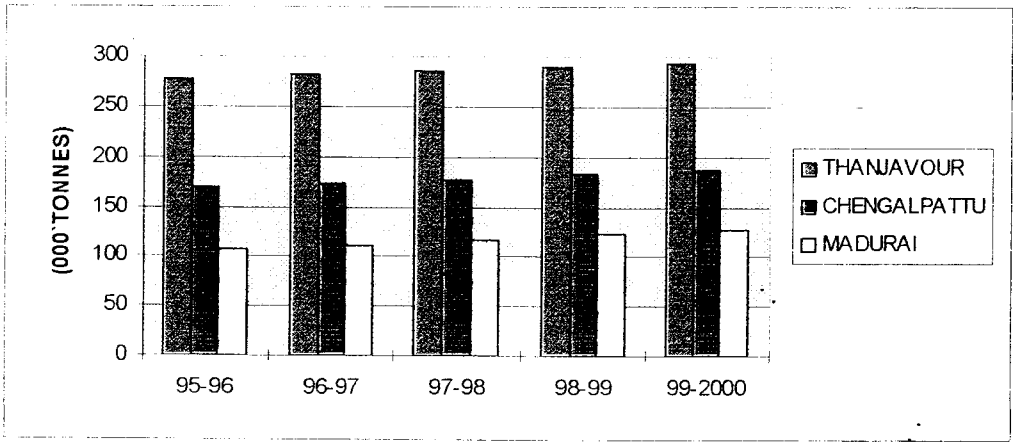
TABLE - 5.09

PROJECTED NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS OF ANDHRA PRADESH

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
i. West Godavari	220	220	220	221	221
ii. East Godavari	179	180	181	181	182
iii. Krishna	217	221	224	228	232
iv. Guntur	219	226	232	239	246
v. Nalgonda	189	200	211	221	232
vi. Srikakulam	106	112	117	122	127
vii. Nellore	121	124	128	131	134
viii. Karimnagar	141	149	157	166	174

Source : Chemprojects Estimates.



5.3.07 **TAMIL NADU**

Among the South Indian states, Tamil Nadu is the second largest rice straw generating state. It had a production of 5 Million tons of straw during 1994-95. The availability in major districts are given in Table - 5.10.

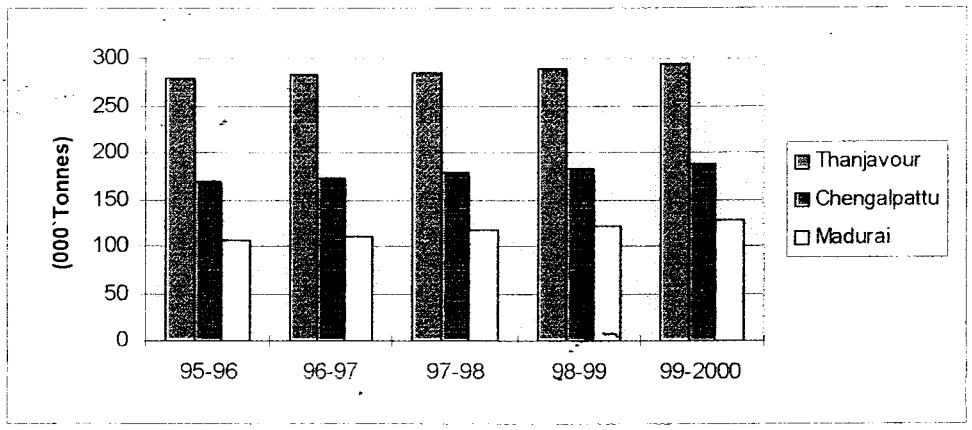
TABLE - 5.10

PROJECTED NET AVAILABILITY OF RICE STRAW IN MAJOR DISTRICTS OF TAMIL NADU.

('000 Tons)

	1995-96	1996-97	1997-98	1998-99	1999-2000
i. Thanjavour	278	282	286	290	294
ii. Chengalpattu	169	173	178	183	188
iii. Madurai	106	111	116	122	127

Source : Chemprojects Estimates.



BAGASSE

5.4.01 The net availability of bagasse in India is dependent upon the production of sugar cane, recovery of bagasse and finally design features of the boiler, operational efficiencies and the fuel preparation method adopted at sugar mills.

5.4.02 A study recently undertaken on behalf of the development council for pulp and paper have estimated that 47.8% of total sugar cane produced is delivered to the sugar factories, 41% for the manufacture of gud and khandsari and 11.2% goes for seed, fuel and chewing etc. As it is stated earlier the bagasse is recovered during production of sugar, gud and khandsari but Gud and khandsari uses almost entire bagasse as captive fuel, therefore possibility of any surplus of bagasse from this sector is negligible. However, sugar industry which is organised and mechanised saves some quantity of bagasse.

5.4.03 The following equation has been applied for calculation of bagasse from sugar cane crushed:-

$$P = Q \times Q1 \times Q2 \times Q3$$

Where P = Net Wet bagasse availability
Q = Total production of sugar cane
Q1 = 0.478, representing the ratio of sugar cane crushed in sugar mills to total sugar cane production.
Q2 = 0.31 representing the ratio of available net bagasse to sugar cane crushed at sugar mills.
Q3 = 0.1 representing the ratio of net surplus wet bagasse to total available bagasse.

Taking the 1994-95 figure for sugar cane production the resultant Net availability of bagasse throughout India for Paper Industry could be calculated as:

Net availability of bagasse = 271.23x0.478x0.31x0.1 For 1994-95 = 4 Million Ton.

5.4.04 On the basis of the above findings the net availability of bagasse in the recent past may be estimated to be of the order as shown in Table - 5.11.

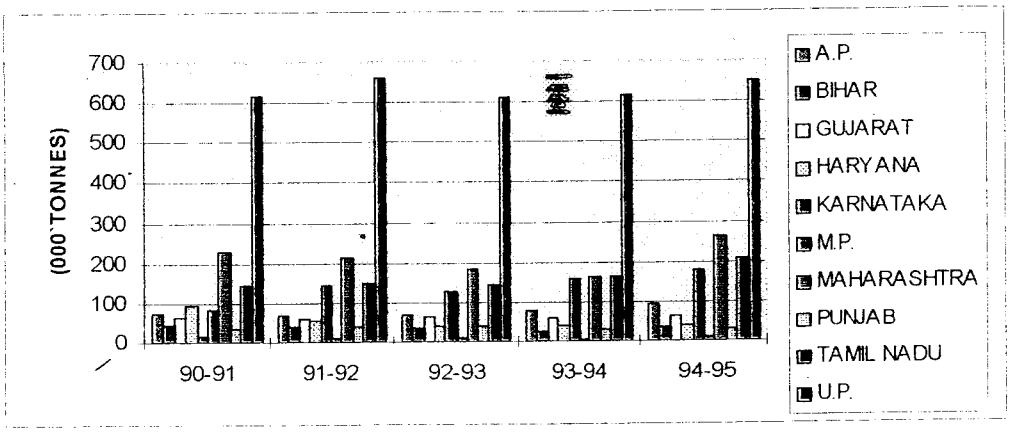
TABLE - 5.11

STATE WISE NET AVAILABILITY OF BAGASSE
(1990-91 - 1994-95)

('000 Tons)

S.No. State	1990-91	1991-92	1992-93	1993-94	1994-95
1. Andhra Pradesh	74.30	69.40	67.20	79.90	94.80
2. Bihar	46.30	41.90	35.80	26.10	33.60
3. Gujarat	62.80	60.70	64.40	60.60	63.90
4. Haryana	96.20	53.30	38.80	38.10	41.50
5. Karnataka	15.20	142.90	128.00	157.70	179.70
6. Madhya Pradesh	82.00	9.80	10.30	6.40	9.00
7. Maharashtra	227.70	214.50	182.90	165.30	262.30
8. Punjab	35.60	41.10	37.80	27.90	30.60
9. Tamil Nadu	144.70	147.50	142.40	165.90	208.90
10. Uttar Pradesh	613.70	658.50	610.20	616.90	651.40

Source: Chemprojects Estimates



5..4.05 The district-wise net availability of bagasse is not projected since most of the sugar mills are operating with mechanised bagasse baler. The baling, collection and procurement systems in this sectors are fully organised and do not require an effort for optimisation unless a high speed baler is introduced which is to be endavoured by the sugar mills themselves.

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CHAPTER - 6

SELECTION OF CLUSTERS FOR BALER DEMONOSTRATION

6.1 GENERAL

61.01 The basic objective of the study has been to identify the clusters with substantial amount of agro-residue availability facilitating their procurement in more organised and economic way. The steps found to be optimally introduced are a scientific collection, transportation, storage and industrial use of straws. The study in hand emphasises more on collection factors, since, these are carried out in a haphazard way in India.

6.1.02 The concept demands for procurement of state of the art technology based balers and adjudge their performance and socio-economic benefits by demonostration in pre-selected farms or a cluster of farms. Semantically, the excercise can be carried out anywhere in India where the straws availability are more than 1.0 lakh tons/annum.

6.1.03 However, there are many other variables clustering around it which preclude the demonostration anywhere and compels for a careful selection of the clusters where demo-units could be run and generalised later on elsewhere if found successful. The major variables considered are:

i. Holding sizes of the farmers.
ii Availability of large farms.
iii. Existence of combine harvesting systems.
iv. At least 1.0 lakh tons of net straw availability within a district which is constituent of a cluster or is a cluster in itself.
v. Farmers positive perception about utilization of modern farm techniques.
vi. Availability of industrial avenues for commercial utilization of the straws etc.

6.2 THE CLUSTERS (ABOVE 1.0 LAKH TON AVAILABILITY)

The clusters of wheat and rice straw availability have been shown in exhibit - 1.

6.3 THE CLUSTERS (FOR DEMONOSTRATION OF BALERS)

6.3.01 It could be noticed from the proceeding chapters that wheat and rice straws are available in several states of India. Even the shortlisting of the district level clusters have revealed a similar dispersions for demonostration of the balers, the following states have been found to be appropriate:

A. RICE STRAW

i. Punjab
ii. Andhra Pradesh
iii. West Bengal
iv. Madhya Pradesh

B. WHEAT STRAW

i. Haryana
ii. Punjab

6.3.02 However, all the states shown above do not enjoy combine harvesting barring the states of Punjab, U.P., Haryana and to some extent Maharashtra and Gujarat. Baling is economically possible only if combined harvesting is in vogue (discussed in detail in chapter - 7). Hence, the district level clusters have been selected considering existence of combine harvesting in zone. The resultant states hence remain to be Punjab and Haryana. Although the state of U.P. does not qualify from net availability point of view for its inclusion in demo-zone however, the combine harvesting system is very much in practice at least in Western and Central U.P. Hence, the Moradabad, Kashipur, Pant Nagar zone could also be considered for demo-zone (of course for convenience purpose).

6.3.03 The estimation of net availability on district level has been done after discounting the consumption of straws by existing agro based pulp and paper units. The resultant districts which could be selected for demo purpose are as indicated in table - 6.01 and 6.02.

TABLE - 6.01.

DISTRICT LEVEL CLUSTERS FOR RICE STRAW SUITABLE FOR DEMO OF BALERS *

Districts	State	Net availability (000 Tons)
East & West Midnapore	West Bengal	400.0
Burdwan	- do -	400.3
Bankura	- do -	200.0
Krishna	Andhra Pradesh	200.0
Guntur	- do -	200.0
Nalgonda	- do -	200.0
Raipur	Madhya Pradesh	250.0
*Sangrur	Punjab	200.0

* Only district of Sangrur in Punjab is reported to be using combine harvester. The situation in Andhra and West Bengal is not known. Moradabad-Kashipur-Pant Nagar zone could also be considered, for the purpose.

TABLE - 6.02

DISTRICT LEVEL CLUSTERS FOR WHEAT STRAW SUITABLE FOR DEMO OF BALERS

Districts	State	Net availability of Wheat straw (000 Tons)
Jind	Haryana	200.00
Sangrur *	Punjab	500.00
Ludhiana	- do -	400.00
Bhatinda	- do -	450.00
Amritsar	- do -	500.00
Faridkot	- do -	520.00
Patiala	- do -	450.00

* The only district with substantial availability of both rice straw as well wheat straw.

6.3.04 In light of the above facts it is concluded that the following districts should be selected and arrangement made for demo of balers once the equipments are procured.

FOR WHEAT STRAW

i. Sangrur (Punjab)
ii. Faridkot (Punjab)

FOR RICE STRAW

i. Sangrur (Punjab)
ii. Moradabad - Kashipur - Pant Nagar zone in U.P.*

* Proposal has already been accepted by Prag farms near Pant Nagar in U.P. (Farm size - 500 acres).

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CHAPTER - 7

BALING NOMENCLATURE AND ITS RELEVANCE

7.1 GENERAL

7.1.01 The role of agro residues in India has been limited to cater to the requirements of households such as fuel, cattle feed, conventional compost making and thatching etc. Resultantly, bulk of the materials have been being used in relatively lesser productive areas. The last two three decades have experienced commercial utilization of it particularly with the growth of agro based paper and paper board industry.

7.1.02 Even today more than 70% of the straws available are used for non-industrial purposes. The abundant availability and uneconomic use never let the farmers feel need of casting a scientific and organised look to collection and commercial aspects of it. However, the growing awareness has at least provided impetus to mechanised harvesting at least in the northern part of the country. The collection of straw is however still almost completely ignored and are fully manual and far expensive for its organised utilization in the industry.

7.1.03 The recovery and procurement of straws are undertaken in a haphazard manner and the scenario vary widely from region to region. Since, the availability heavily depends upon the harvesting and recovery systems, it is imperative to examine the comparative economic fallout of the harvesting systems.

7.2 HARVESTING SYSTEMS

7.2:01 It has been mentioned earlier that in India there are two types of harvesting systems in vogue. These are :

i. Manual harvesting.
ii. Combine harvesting.

7.2.02 Out of the above, majority of the crops are harvested manually. The combine harvesting is in vogue in Punjab, Haryana and Western Uttar Pradesh. However, the combine harvesters in Western Uttar Pradesh have started functioning in central and Eastern Uttar Pradesh and also in Rajasthan on rental basis. The system is also reported to be in use in Maharashtra and Gujarat to some extent. As per G.B. Pant Agriculture University estimates, presently, there are 6000 combine harvesters in operation throughout the country.

7.3 STRAW HANDLING IN MANUAL HARVESTING

7.3.01 In manual harvesting the crops are cut at 5 to 10 c.m. above the ground level. The crops harvested are brought to a Centralised place for threshing either through a mechanised thresher or through cattle walk or manually. The straw recovered if threshed mechanically retain an organised shape and stored in loose form or baled manually without much compressing the volume and staked in open place.

7.3.02 If threshed through cattle walk or mannually, the straw is crushed by human or cattle feet and losses its shape. These straws recovered after separation of grain are just dumped in an open space for different consumption purposes. In both the cases, it is not economically viable to transport the straw for industrial applications. Secondly, the straws also start decaying after sometime due to their storage in open place inviting moisture heat, rain and rodents.

7.3.03 The typical logistic economics involved in bringing these straws to a mill site could be estimated as:

A.	Assumed distance	-	50 Kms.
B.	Straw weight per truck (full size)	-	4 tons (maximum)
C.	Truck charges for 50 Kms.	-	Rs. 1000.00
D.	Loading and unloading expenses (Per Ton)	-	Rs. 200.00
E.	Total expenses on logistics	-	Rs. 1200.00
F.	Logistics expense per ton (for 50 Kms.)	-	Rs. 300.00
G.	Logistics expense	-	Rs. 6.00 Per ton/Per Km.

7.3.04 In addition to the above, a mill has to pay some price to the farmers and the middlemen. All added together, the landed price range between 500/- per ton to as high as Rs. 700/- per ton depending on market forces and the location of the mill, making the utilization viability sometimes questionable. The unbaled nature of the straw is main contributor to the higher landed price. The situation is further deteriorated due to loss of straw in transit by wind blowing and road jerks ranging between 2 to 5% of total straw loaded.

7.4 THE BALING EQUIPMENTS

7.4.01 There is a solution to collect the straws in baled form for the purpose, a baling equipment is required to bale the straws. The baling equipments (i.e. baler) could operate in two ways:

i. Stationary and
ii. Mobile

7.4.02 In India, more than 80% of the farmers are using manual harvesting method. Hence, the stationary balers could be the most optimum and desired type of balers in India. However, the harvesting methods in Punjab, Haryana and Uttar Pradesh etc. Shall be requiring Mobile balers since majority of the farmers in these states are utilizing combine harvesting method.

7.4.03 As a result, a combination of stationary as well as mobile balers could be the right choice to meet the objectivity of this study. However, procurement and operation of stationary balers are surrounded with many constraints, discussed in succeeding paragraphs.

STATIONARY BALERS

7.4.04 Internationally, the stationary balers particularly for straw baling, have gone obsolete. Resultantly, a comprehensive hunt for locating supply of stationary balers yielded a limited result. There has been only one firm claiming to supply stationary balers for straw baling i.e. M/s. Kay Iron Works located at Yamuna Nagar of Haryana in India.,

7.4.05 M/s. Kay Iron Works are one of the most reputed suppliers of stationary balers in India. The balers supplied by them are mostly suitable to bale wet bagasse. The company claims to have supplied a baler for wheat straw baling also. In view of the above, a detail discussion about operational aspects was held at their plant at Yamuna Nagar during which it was found that:

1. The baler supplied by them are to be fixed at one place on a concrete structure and cannot be shifted without dismantling.
2. It operates through a 30 H.P. motor which is driven through electricity.
3. The baler is capable of baling straws only upto 50 c.m. in length and anything above 50 c.m. cannot be handled.
4. The baler requires straw with about 30-50% moisture. Since the straws are mostly dry, a moisturising binder is required for the purpose. Presently, molasses are being used as binder.
5. The baler has a speed of 30 RPM producing about 80 to 100 bales per hour with a bale weight of 20 Kgs. each.
6. It requires a maintenance cost of about Rs. 10,000/- per annum.
7. Bale stiching is done manually where two persons are to stich the outcoming bales on both the sides of baler.
8. Straw feeding could be done either through a conveyor or manually which requires about 2-3 labourers.
9. Jute twines could be used.
10. The baler is to be transported at sites in two parts and can be assembled there.
11. Weight of the baler is about 5.5 tons.
12. During operation it creates lot of vibration and hence could not be fixed on a wheel attached cart or trolley.

7.4.06 The above factors suggest that these balers could not achieve the desired objectives due to following reasons:

1. These balers are to be fixed at one place which means that it will hardly take care of a village or two.

2. Application of a binder such as molasses could be suitable if the straws are to be used as a fodder. Use of molasses shall affect the paper quality adversely as the straws are to be used for paper making.

3. Straw sizes vary widely from region to region and crop to crop. The baler's limitation to be capable of handling the straw upto 50 c.m. length only will not be acceptable to the crops yielding straws with larger length.

4. The balers are operated through electricity, which may not be available in most of the villages. Even electrified villages do not get a regular power supply in most of the states.

5. The baler operation requires about 5 persons. Considering an average wage of Rs. 50/- per person per day, the wage above could result to about Rs. 250/- a day for about 16 tons of baled straw at 8 working hours. Hence, the wage alone will be about Rs. 16/- per ton of straw. Even the other operational economics do not allow application of these balers at least for the straws to be used in paper industry.

7.5 MOBILE BALERS

7.5.01 In combine harvesting, the crops are harvested through a mobile machine named combine harvester. It cuts the crop at 20 c.m. height above the ground level however, the same can be adjusted and brought down upto 5 c.m. above the ground level. There is an inbuilt thresher which automatically separates the grains and leaves the straw in the field.

7.5.02 Combine harvesting is getting popular day by day. It has already made inroads in Punjab, Haryana and Western U.P. to almost full extent and moving fast to the central and eastern part of U.P. There are many organisations involved in assembling combine harvesters in Nabha area of Punjab. However, still the John Dere make of combine harvesters and Swaraj (PunjabTractors Ltd.) are the most commonly used combine harvesters.

7.5.03 The farmers prefer it due to inherent economics and operational advantages. The typical rent varies between Rs. 275 to Rs. 400 per acre depending upon the demand supply forces for harvesting of the same amount, a farmer requires about 20 mandays costing them a minimum of Rs. 800/- for the operation. Threshing charges also accumulates to about Rs. 300/- for one acre on an average. Hence the operation is over within a maximum of Rs. 400/- per acre instead of Rs. 1,100/- by mannual harvesting and threshing, further, handling headache is also saved.

7.5.04 The major hindrance in straw collection in combine harvesting is the non-availability of balers. During combine harvesting the straws are left over on the field and are highly scattered throughout the area. Application of stationary baler is ruled out because the cost involved in collection of straws are substantially high. Normally 1 acre of crop requires about 10 labourers for collection of wheat straw left in the field. The collected straw averages to about 2 tons of straw. Hence, the labour cost involved in collection of straw comes to about Rs. 200/- per ton of wheat straw. In case of Paddy straw it goes further up as grain straw ratio is comparatively less. This is why most of the farmers in Punjab, U.P. and Haryana prefer to burn them in the field than collecting and making an use of it.

7.5.05 In the above scenario, baling of straws is found to be useful on different socio-economic considerations. A mobile baler could be the best answer to overcome the above problem.

7.5.06 The mobile balers are tractor mounted and derives power from the tractor for operation. In developed countries, it normally trails behind the combine harvester however in India the farmers want their field to be vacated within 1 to 2 weeks time to initiate activities for the next crop.

7.5.07 Straw feeding is not required in mobile balers as it collects the straw automatically and bales them in the field. The operational economics are as follows:

1.	Cost of baler	:	Rs. 4.50 lakhs (maximum), imported.
.2.	Interest on equipment (@ 20% per annum)	:	Rs. 0.90 lakhs per annum.
3.	Cost of 45 H.P Tractor (Including accessories and tax etc.	:	Rs. 3.0 lakhs.
4.	Interest on tractor cost	:	Rs. 0.60 lakhs per annum.
5.	Total operational day (baler) in a year.	:	120 days
6.	Total operational hours @ 10 hours a day	:	1200 hours in a year.
*7.	Bale produced per hour (round bales)	:	75 bales of 25 Kgs. each
8.	Total bale produced in a year	:	90,000 nos.

9.	Total bale produced in a year (weitage)	:	2250 Tons
10.	Diesel to be consumed per hour.	:	4.5 liters
11.	Diesel to be consumed per year (120 days)	:	5,400 liters
12.	Cost of Diesel	:	Rs. 9/- per liter (averaged)
13.	Total cost on diesel per annum	:	Rs. 48,600/-
14.	Salary of Driver and operator (for 4 months) (@ 2000/- P.M. each	:	Rs. 16,000/-
15.	Repair & maintenance		
	a. Baler @ 5%	:	Rs. 22,500/-
	b. Tractor (Lumpsum)	:	Rs. 5,000/-
16.	Twine @ Rs. 1.33 per bale	:	Rs. 119,700/-
17.	Total operational cost per year. (2)+(4)+(13)+(14)+(15)+(16)	:	Rs. 361,800/-
	Cost per bale	:	Rs. 4.02 or say Rs. 4.0/- per bale of 25 Kgs.
	Cost of baling per ton	:	Rs. 160.80 per ton or say Rs. 161 per ton of straw.

* Depends on density of crop but normally ranges between 75-100 bales per hour.

Note: The calculations are based on rectangular balers.

Source of calculation : Working of New Holland model of baler at their farm at Palwal - Sohna Road, near New Delhi.

7.5.08 In terms of operation cost per hour it amounts to about Rs. 301.50/- per working hour which can be kept in mind while renting out the balers. It will be worth considering the logistics economics involved in transportation and handling of such baled straws to the mill site as attempted in succeeding paragraphs.

7.5.09 In addition to the price to be paid to the farmers the following expenses are to be incurred for transportation of the baled straw:

A.	Assumed distance	-	50 Kms.
B.	Straw weight per truck (full size)	-	8 tons (maximum)
C.	Truck charges for 50 Kms.	-	Rs. 1000.00
D.	Loading & unloading expenses (per truck)	-	Rs. 200.00
E.	Total expenses on logistics support	-	Rs. 1200.00
F.	Logistics expense per ton (for 50 Kms.)	-	Rs. 150.00
G.	Logistics support per ton/K.m.	-	Rs. 3.00

7.5.10 It is evident from above calculations that a paper mill can procure baled straw at 40% cheaper rate than loose one alone on account of transportation. The other benefit of the exercise results in terms of a net saving of more than Rs. 200/- per ton which otherwise could have cost to the farmers in collection of straw. Even if a farmer is offered a price of this extent or even less it will heavily add to his income which otherwise goes just waste.

7.5.11 The mobile balers offer three different shapes of bales:

1. Round Bales.
2. Rectangular Bales.
3. Square Bales.

7.5.12 Density of balers under different shapes vary widely. Round baler have higher density than its counterpart as shown below:

i.	Square/Rectangular bales	-	Density 150-200 Kgs/Cu.m.
ii.	Round Bale	-	Density 300 Kgs/Cu.m.

7.5.13 Round bales have a higher density because it is wrapped during compression and hence the straws are bend and tightly connected with each other. In case of square or rectangular bales, the particles are not in close connection as bulk of the particle is not bend. Normally, a bale chamber size with cross section of 35 c.m. x 46 c.m. delivers a density of 125 Kgs/Cu.m. if it is rectangular or square. However, length of the cross section could be increased upto 120 c.m. depending on volume size of bale desired (maximum upto 50 Kgs.).

7.5.13 The balers producing round bales could have been an optimum proposition as the bale sizes begin with 300 Kgs. each. However, it has its own limitations, particularly in Indian condition.

7.5.14 The round bales used to have a higher volume weight which could not be lifted manually. The lifting of bales shall require a fork lifter which is again crane and tractor mounted. The roads in the villages are too narrow to permit movement of these equipments. Secondly, these additional equipments are capital intensive. Even the round balers have a comparatively longer and higher sizes with large turning radius. The small dimesion of Indian field shall not accomodate a free movement of these equipments and there shall be enormous loss of efficiency on operational grounds.

7.5.15 A typical comparison of operational expenses between rectangular and round balers have been provided by one of the leading baler suppliers given in table - 7.01.

TABLE - 7.01

OPERATIONAL COST COMPARISON BETWEEN ROUND AND RECTANGULAR BALERS.

S. No.	Factors	Round Balers Rate	Annual Cost (Rs.)	Rectangular Balers Rate	Annual Cost (Rs.)
1.	Cost of Baler. Interest (20%)	Rs. 600,000	120,000	454,300	90,860
2.	Cost of tractor 75 up tractor (4 months)	250,000		100,000 (35 H.P.)	
	Interest (20%)		50,000		20,000
3.	Operational days	120		120	
4.	Operational hours @ 10/days.	1200		1200	
5.	Bales per hour	7		75	

S. No.	Factors	Round Balers Rate	Round Balers Annual Cost (Rs.)	Rectangular Balers Rate	Rectangular Balers Annual Cost (Rs.)
6.	Bale weight (Kg.)	320		25	
7.	Bales per year	8400		90,000	
8.	Tonnes per year	2688		2250	
9.	Fuel consumption (litres/hour)	4.5		4.5	
10.	Fuel consumption (litres/year)	5400		5400	
11.	Cost of fuel (Rs./litre)	9	48,600	9	48,600
12.	Drivers wage (Rs./month)	2000	8,000	2000	8,000
13.	Repair maintenance (Baler)	5%	30,000	5%	22,715
14.	Repair maintenance (Tractor)	5%	12,500	5%	5,000
15.	Twine @ 800 per pair for 80 baler.	10	84,000	1.33	119,700
16.	Annual running cost		353,100	314,875	
17.	Cost per ton.		131	140	
18.	Crane hire.	@ Rs.400/ hour	480,000		
19.	Cost per ton.	-	178	Nil	Nil
20.	Total cost per ton.	-	309	140	

7.5.16 It is evident from above comparison that there is a substantial difference in the operational cost arising out of two varieties of balers. The operational cost per ton of straw in case of round balers estimates to about Rs. 309 which is only about Rs. 140 in case of the rectangular balers. Besides, the other constraints such as procurement of crane mounted fork lifter and infrastructural hindrances in movement of round balers etc. also precludes use of round balers in India. Hence, the rectangular balers could be the only solution of the problem under study.

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CHAPTER - 8

SELECTION OF BALERS

8.1 GENERAL

8.1.01 Baling machines are equipments used in binding of straws/bagasse narrowing their volume size enabling easy and economic transportation of them. It also results in a convenient storage of them, besides, the bales are of uniform size and weight and could be staked on top of each other.

8.1.02 In India, only bagasse is being mechanically baled. Baling of wheat and rice straw is still in infancy and mostly manual methods are being utilized. Mechanised bales have not been reported to be used by even a handful of farmers however, some of the institutions and agricultural universities are in possession of it.

8.1.03 In developed countries, the balers are used just after the combine harvesters harvest two crops. The harvester harvests the crops, the inbuilt threshers thresh them out and the residual i.e. straws are baled through the balers. These balers are capable of delivering bale sizes of upto as high as 700 Kgs. The heavy balers are fork lifted and put in the attached trolley for transportation to the storage point.

8.2 BALING SITUATION IN INDIA

8.2.01 Baling of straws on mass level are still unheard in India. Manual baling are done by the farmers with variance in sizes and shapes in different regions of the country. The manual balings are normally done for storage of the straws to use them for household purposes. The bales baled manually are bulky in nature and not uniform in size, weight and shape and hence not valid for economic transportation.

8.2.02 A handful of farmers tried baling by stationary balers which were not found to be operationally and economically viable on the grounds already explained in previous chapters of this report. Similarly the mobile balers are not being used due to their non-availability and also farmer's reluctance to use them for as there are no buyers of the baled straws. Thirdly, all the regions in the country are not possessing combine harvesters and hence a mobile baler is of no use to them.

8.2.03 Balers being a capital intensive equipment (at least for a farmer), farmers are not in position to invest in it. However, a preliminary survey in Haryana and U.P., has revealed that the farmers are willing to hire the equipments if buyers of the straws exist and the operation is economically viable. Even a small price for straw emerging as net surplus to the farmers they will welcome the concept. However, willingness to invest in the equipment is abysmally low.

8.2.04 The first mobile baler was imported in India by Pant Nagar Agricultural University for their R & D purpose. The equipment under brand name "CLASS" was imported from Germany in mid-seventies. The baler is still in operation in the university and used for R & D purpose of the university. Similarly, NDDB in Gujarat has imported six balers from class and are using them to bale the straw for fodder purposes.

8.2.05 Early eighties ,experienced mushrooming growth of agro based paper and paper board units in Punjab and Western U.P. resultantly, the farmers felt need of combine harvesters and balers in expectation of commercial gains out of straw. Combine harvesters were imported from U.S. and Europe and later on started getting assembled in India itself. Even today, Nabha area of Punjab is full of such assembling units. Smelling a good future demand for balers M/s. Punjab tractors under brand name of "SWARAJ' started indenting imported balers and later on assembling them as well. The largest order came from Punjab State Electricity Board, which procured 36 balers in one go for their proposed bio-mass based power generation unit. The demand for baler however did not flourish at expected level and M/s. Punjab Tractors discontinued manufacturing of it. However, M/s. Escorts are studying the feasibility of introducing it in collaboration with an European company namely CLASS. Hence, presently, a mobile baler has to be imported from other countries.

8.3 BALE SHAPE AND VOLUME WEIGHT

8.3.01 Straws could be baled in three shapes:

i. Square.
ii. Rectangular and
iii. Round.

8.3.02 Density of the bales under different shapes vary widely. Round bales have higher density than its counterpart as shown below:

i. Square/Rectangular bale - Density 150-200 Kgs./Cu.m.
i. Round bale - Density 300 Kgs./Cu.m.

Round bales have a higher density because it is wrapped during compression and hence the straw are bend and tightly connected with each other. In case of square or rectangular bales, the particles are not in close connection as bulk of the particle is not bend. Normally, a bale chamber size with cross section of 35 c.m. x 46 c.m. delivers a density of 125 Kgs./Cu.m. if it is rectangular or square. However, length of the cross section could be increased upto 120 c.m. depending on volume size of bale desired (maximum upto 50 Kgs.).

.8.3.03 In Indian condition, a bale size of 30-50 Kgs. could be a preferred option from handling point of view. However, there will be a substantial operation loss if one opts for balers delivering square rectangular bales. Round baler could be an optimum option as it delivers a well compressed straw with higher volume weight and hence speed of the baler is also higher in terms of weightage of straw per minute of baler operation. However, the lowest weight of round bales have bee reported to be 300 Kgs. per bale, inviting problems of handling and use of a crane mounted fork lifter further making it operationally expensive.

8.4 THE SOURCES OF SUPPLY OF BALING EQUIPMENTS

8.4.01 About twenty leading manufacturers/suppliers of baling equipments in U.S.A., Europe and Israel were contacted to obtain their quotations for supply of balers. In India, four identified manufacturers of balers were contacted for the purpose. However, only three firm quotations from overseas suppliers were received. Among identified Indian suppliers only one responded to the enquiry. However, a detailed discussion with them revealed that those balers are operationally not viable for baling of wheat and rice straw.

8.4.02 In case of bagasse balers, only two manufacturers have forwarded their firm offer. The details of all the suppliers from whom the offers have been received have been discussed in succeeding paragraphs. (The offers for bagasse balers have not been discussed as all the Sugar mills are already in possession of it).

WHEAT/RICE STRAW BALING MACHINES

8.4.03 In this category, only three offers have been received. The offers have been received from:

i. M/s Gallignani S.P.A.
via Molinaccio
10-48026, Russi (RA) Italia

ii. M/s John Dere Export
Steubentrasse 36-42
58140 mannheim
West Germany.

iii. M/s New Holland Tractors (I) Pvt.Ltd.
210,Okhla Inds. Area-III
New Delhi - 110 020.

8.4.04 The detailed offer from these companies are annexed as Annexure - I & II and III of this report. The analyses of their product range and technical suitability and prices are discussed here under:

8.4.05 The comparison of offers received for different balers have been attempted as enclosed in succeding tables.

TECHNICAL D.C.S FOR BALERS

ONLY FOR SELECTED MODELS

Particulars	M/s. John Dere Export		M/s. Galignani S.P.A		M/s. CLASS R&A		New Holland Tractors	Remarks.
Name & Address	M/s. John Dere Export Steudentrasse 30-42 58140, Mannheim West Germany		M/s. Galignani S.P.A Via Molinaccio 10-48026, Russi (RA) Italy.		M/s. CLASS R&A P.O.Box 1163 D-33426, Harsewinkel		New Holland Tractors (India) Pvt. Ltd. 201, Okhla Indl. Area-III New Delhi - 20.	
Qtn. ref. no.	542 10059		Dir. Comm. DP/FG/SG		-			
Dated	21.10.96		25.10.96		20.06.97.		18.06.97.	
Telephone	49-621-8104-541		0544/589201		05247-121272		011-693220	
Fax	49-621-8104-395		0544/581282		05247-121311		693208	
Concern Person	Mr. J. Voigt/A. Lobas		Mr. F. Gianaico		Mr. Klaus Gebhard.		Mr. A.K. Ghosh.	
Type (Square/Round)	"SQUARE"	"ROUND"	"SQUARE"	"ROUND"	"RECTANGULAR"	"ROUND"	"RECTANGULAR"	Square baiers of 25 to 40 Kg. weight are available and in round baiers the weight is around 300 Kg.
Model No.	359 Twine baler	510 Round baler	3090S	2200	Markant 65	Rolant 46 Silage	565-T. Twine-Tie baler.	
Bale Size	36x46 CM.	1.1M x 0.8-1.3M.	36 x 46 CM.	1.2 x 1.25 Dia	36 x 46CM.	1.2 x 1.2	36 x 46CM.	
Bale Weight	7.5 to 31.5 Kg.	320 Kg.	Not specified	Not specified	Approx. 30 Kg.	300 Kg. (approx.)	25 Kg.	
Production Capacity	Depends on length of bale. (i.e. 0.3M. to 1.3M)	35 Bales of 320 Kg/Hr.	Depends on length	Not specified	Depends-as bail length (0.4 to 1.10M)	Not specified.	75 Bales/Hr.	
Twine required	2.6 to 6.6M per bale	Not applicable	Not specified	Not specified	Not specified	Not specified.	Rs. 1.33 per bale.	
Pick-UP	1.56 M inside & 1.75M outside width.	1.41 M.	1.70 M.	Not specified	Not specified	1.8M & 1.58M	1.8M.	
Base Equipment Contains	1. Longer Feeding Auger w/Deflector.	1. Bale density control valve.	1. Tyres 205.75-15 Left 185.14 Right. Cardan Shaft.	1. Tyres 10.0/75-15.	1. Extended drawbar with a two section P.T.O shaft.	1. Hydraulic lift for pick-up.	1. Adjustable packer fork.	
	2. Adjustable Feeding Fork.	2. Main & Bale Twin Box.	2. Braking kit.	2. Wide angle cardon shaft.	2. Adjustable drawbar to ensure correct hitching on all tractors.	2. Wide angle free wheeling P.T.O. shaft.	2. Gear-driven knotters.	
	3. Plunger head.	3. Bale twin storage.	3. Swivel Ring Hitch.	3. Bale counter.	3. Adjustable support jack for easy hitching.	3. Automatic chain lubrication.	3. Rugged bale chamber.	
	4. Rear reflectors.	4. Double tying arm.	4. Short crop baffle for 3090.	4. Electric system.	4. Heavy flywheel ensures smooth transmission and max. power transference.	4. Hydraulic pick-up wheel.	4. High capacity feeding systems.	

Particulars	M/s. John Bare Export		M/s. Caligmani S.P.A		M/s. CLASS KGaA		New Holland Tractors	Remarks.
	5. Multiub Greasing system in knotter area.	5. Bale shape indicator.	5. Automatic lubricating system for 2/twine knotter.	5. Pneumatic Pick-up wheel.	5. Hydraulic gear box.	5. Hydraulic system.	5. Floating wind guard.	
	6. Tripple twine holder.	6. Safety front & rear shield.	6. Drawbar Extension.	6. Automatic lubricating system for Extra.	6. Heavy duty ram.	6. Automatic twine tying system.	6. Floatation tires.	
	7. Integrated loading hooks.	7. Bale counter & mech. bale dia indicator.	7. Iron Bottom Roller.	7. Bale kicker for 2200.	7. Shaft drive for feeders and knotters.	7. Adjustable draw bar.	7. Belt driven pick-up.	
	8. Mech. Tongue positioning.	8. Mechanical Pick-up lift.	8. Rear rubber wheel.	8. Wedges for tail gate.	8. Hydraulic lift pick-up from tractor seat.	8. Convenient knife control.	8. Pick-upg gauge wheel.	
	9. Side nay Retainer.	9. Safety shield.	9. Rubber Pick-up wheel & Pneumatic Pick-up wheel.	9. Short crop divoting baffle plate for 2200.	9. Rotary feeders.	9. Electro magnetic knife meter.	9. Strong plunger.	
	10. Bale Counters.	10. Side Flare Crop Guides.	10. Left support skid.	10. 3 way valve.	10. Adjustable feeders.	10. Double twine coraping with automatic system.	10. Large feed opening.	
	11. Special Shielding.		11. Pick-up Hydraulic lift.	11. Kit for 3 additional rollers.	11. Angled stationary knife reduces the power required to cut the crop.	11. Precision cutting system.	11. Fast plunger speed, long plunger stroke.	
			12. Drawbar Hydraulic adjustment.	12. Automatic lubricating system.	12. Simple & reliable shaft driven CLAAS knotters.	12. Hydraulic over load protection.	12. Large, 22 inch fly wheel.	
			13. Drawbar Mechanical adjustment.	13. Net wrap 'Rotomec' with Elec. control for 2200.	13. Galvanised sheet metal [illegible]sheets for improved [illegible] protection.	13. Bale discharge ramp with electrical bale clearance signal.	13. Slip clutch protection.	
			14. Wide angle cardan shaft.			14. Pressure gauge.	14. Large drive tine.	
			15. Bale counter.			15. Lock valve.		
			16. Electric system.					
Tractor Power Required.	55 H.P	45 H.P	Not specified	45 H.P	45 H.P (Estimated)	70 H.P.	35 H.P.	

ESTIMATED OPERATING COST OF ROUND AND RECTANGULAR BALER

M/S. JOHN DERE EXPORT

S.No.	Particulars	M/s. John Dere Export		M/s. Gallignani S.PA.				
	Name of the Company Type	M/s. John Dere Export Square	Round	M/s. Gallignani S.PA. Square	Square	Square	Square	Square
A.	Model No.	359 Twine	570 Round baler	1500 S	1800 S	2690 S	3690 S	3690 F
B.	Cost of Baler Delivered Delhi Including Customs Duty & Excise & Transportation	Rs. 671,381	835,153	419,100	431,800	453,390	462,280	504,190
	Interest @ 20%	134,276	167,030	83,820	86,360	90,678	92,456	100,838
C.	Cost of Tractor (45 hp/75 HP)	300,000	700,000	300,000	300,000	300,000	300,000	300,000
	Interest 20%	60,000	140,000	60,000	60,000	60,000	60,000	60,000
D.	Operational Days	120	120	120	120	120	120	120
E.	Operational Hours @ 10/Day	1200	1200	1200	1200	1200	1200	1200
F.	Baler Per Hour	75	7	60	60	70	70	75
G.	Bale Weight(Kg)	25	320	25	25	25	25	25
H.	Bales Per Year	90,000	8,400	72,000	72,000	84,000	84,000	90,000
I.	Tonnes Per Year	2250	2688	1800	1800	2100	2100	2250
J.	Fuel Consumption Per Hour in Litres	4.5	7.5	4.5	4.5	4.5	4.5	4.5
K.	Fuel Per Year (In Litre)	5400	9000	5400	5400	5400	5400	5400
L.	Cost of Fuel/Annum @ Rs.9/-	48600	81000	48600	48600	48600	48600	48600
M.	Driver @ Rs.2000/ Month(For 4 Months)	8000	8000	8000	8000	8000	8000	8000
N.	Repair/Maintenance (Baler)5% of cost	33,569	41,757	20,955	21,590	22,670	23,114	25,210
O.	Repair/Maintenance (Tractor)5% of Cost	15,000	35,000	15,000	15,000	15,000	15,000	15,000

ESTIMATED OPERATING COST OF SQUARE AND ROUND BALERS

Name of the Company M/s. John Dere Export M/s. Galignani S.PA.

	Name of the Company	Galignani	Galignani	Galignani	Galignani	Galignani	Galignani	Galignani
S.No.	Type	Square	Square	Round	Round	Round	Round	Round
A.	Model	5190 S	5190 F	2110 Extra	2200 Extra	2200 AR	2200 L	2200 LR
B.	Cosf of Baler Delivered at Delhi including Sales Tax, Excise import duty & Transportation	Rs.542,290	Rs.584,200	Rs.558,800	Rs.615,950	Rs.701,040	Rs.706,120	Rs. 791,210
	Interest @ 20%.	108,458	116,840	111,760	123,190	140,208	141,224	158,242
C.	Cost of tractor	Rs 300,000	Rs 300,000	Rs 700,000	Rs 700,000	Rs 700,000	Rs 700,000	Rs 700,000
	45 HP/75 H.P							
	Interest @ 20%.	60,000	60,000	140,000	140,000	140,000	140,000	140,000
D.	Operational Days	120	120	120	120	120	120	120
E.	Operational Hours	1200	1200	1200	1200	1200	1200	1200
F.	Bales per hour	75	75	7	7	7	7	7
G.	Bale weight (Kgs)	25	25	300	300	300	300	300
H.	Bales per year	90,000	90,000	8,400	8,400	8,400	8,400	8,400
I.	Tonnes	2250	2250	2520	2520	2520	2520	2520
J.	Fuel consumption per hour in litres.	4.5	4.5	7.5	7.5	7.5	7.5	7.5
K.	Fuel per year. (In Litre)	5,400	5,400	9,000	9,000	9,000	9,000	9,000
L.	Cost of fuel per annum @ Rs. 9/-	48,600	48,600	81,000	81,000	81,000	81,000	81,000
M.	Driver @ Rs. 2000/month (for 4 months)	8,000	8,000	8,000	8,000	8,000	8,000	8,000
N.	Repair/Maintenance (Baler @ 5%)	27,114	29,210	27,940	30,797	35,052	35,306	39,560

	Name of the Company	Galignani	Galignani	Galignani	Galignani	Galignani	Galignani	Galignani
S.No.	Type	Square	Square	Round	Round	Round	Round	Round
O.	Repair/Maintenance (Tractor @ 5%)	15,000	15,000	35,000	35,000	35,000	35,000	35,000
P.	Twine @ 800 per pair for Round @ 10/bale Rect. @ 1.33/bale	119,700	119,700	84,000	84,000	84,000	84,000	84,000
Q.	Annual Operating Cost (B+C+L+M+N+O+P)	Rs. 386,872	Rs. 397,350	Rs. 487,700	Rs. 501,987	Rs. 523,260	Rs. 524,530	Rs. 545,802
	Cost per tonne	171.94	176.60	193.53	199.20	207.64	208.14	216.58
S.	Crane Hire @ Rs. 400/Hr. for 1200 hrs Rs. 4,80,000/-	N.A.	N.A.	190.47	190.47	190.47	190.47	190.47
T.	Total Cost/Tonne	171.94	176.60	384.00	389.67	398.11	398.61	407.05

* NOTE : The above is excluding the packing & forwarding charger. It should be applicable to Galignani as well as John Dere Export.

S.No.	Name of the Company	New Holland
r.	Cost Per Tonne	156.57
s.	Crane Hire @ Rs. 400/Hr. for 1200 Hrs. = Rs. 4,80,000	N.A
t.	Total Cost Per Tonne	156.57

CONCLUSION :

1. From the above analysis it is seen that, model 565-T rectangular baler could be a technically and economically suitable proposition in India and it requires 35 Kw. Power. Bale size is 36 x 46cm. Here the production capacity is more than 75 to 200 bales per hour of approx. 25 Kg. each. Again it depends on the loses.

2. In rectangular balers the model 565-T prefered since the handling of rectangular small size bales are easy and consuming less power (i.e. 35 H.P.) when compare to other models.

3. Handling of round balers are very difficult due to heavy weight. It requires crane to handle the bales. Therefore for Indian conditions round balers should be avoided.

4. The second choice could be model Markant - 65 of CLASS KGaA and which requires only 45 H.P. tractor for handling however, the commercial offer is yet not received from them.

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S.No.	Name of the Company	New Holland
	Type	Rectangular
a.	Model	NH-565
b.	Cost of Baler Delivered at Delhi including Sales Tax, Excise, Import Duty & Transportation	Rs. 4,54,000
	Interest @ 20%	Rs. 90,800
c.	Cost of Tractor 45 HP/75 HP	Rs. 2,50,000 (35 HP Tractor)
	Interest @ 20%	50,000
d.	Operational Days	120
e.	Operational Hours	1200
f.	Baler Per Hour	75
g.	Bale Weight (Kgs.)	25
h.	Bales Per Year	90,000
i.	Tonnes	2250
j.	Fuel Consumption Per Hour(in Litres	4.5
k.	Fuel Per Year(Litres)	5400
l.	Cost Fuel Per Annum (@ Rs. 9/Litre)	48600
m.	Driver @ Rs. 2000/ Month(for 4 months)	8000
n.	Repair/Maintenance (Baler) @ 5%	22,700
o.	Repair/Maintenance (Tractor) @ 5%	12,500
p.	Twine @ 800 Per Pair for Round @ 10/bale for Rect./Square @ 1.33/Bale	1,19,700
q.	Annual Operating Cost (B+C+L+M+N+O+P)	3,52,300

CHAPTER - 9

SOCIO-ECONOMIC RELEVANCE

9.1 GENERAL

It has already been discussed in preceeding chapters that in India more than 75% of the straw availabilities are being used in highly unproductive areas and the residuals are just disposed off. The scenario prevails due to constraints in collection, baling and industrial utilisation of them. Resultantly, Rupees millions of worth of straws are lost in lack of proper infrastructure required for harvesting, collection and industrial utilization of them.

9.1.02. The straws, being lost or utilized in unproductive or lesser productive areas could be well diverted to proper utilization of them. Among varieties of agro-residues, wheat and rice straws have been found to be quality fibre for paper making. Its importance becomes more vital in Indian context as the country is facing acute scarcity of natural wood required for paper making.

9.1.03 The above constraints surrounding collection and industrial use of straws, could be handled through utilization of mechanised baling equipments to some extent. However, it further requires optimisation of harvesting methods and education of the farmers about commercial value of the straws.

9.1.04 Introduction of mechanised balers shall have multiple socio economic advantages as outlined in succeeding paragraphs.

9.2 VALUE ADDITION ORIENTED

9.2.01 As per estimates, India generated a gross availability of 52 million tons of rice straw and about 96 million tons of wheat straw in 1995-96. Out of which, after utilization in other conventional activities, about 22 million tons of wheat straw and 15 million tons of rice straw emerged as net surplus. These net surpluses are either just burnt in the field or used as domestic fuel yielding zero return to the farmers. Certain quantities are also used for compost making which has no visible commercial gain.

9.2.02 Introduction of balers shall facilitate a transportable shape of the straw which in turn shall be procured for industrial use. Even if a bottom line price of Rs. 100/- per ton is assumed to be paid to the farmers, the system shall provide a net price to the extent of Rs. 3700 million to the farmers. The straw thus collected and used in paper making shall produce about 10 million tons of paper yielding a gross price of Rs. 200,000 million at an average price of Rs. 20,000 per ton of paper.

9.2.03 In other words, there will be a value addition of about Rs. 200,000 Million which is about 54 times of the price of straw to be paid to the farmers. The scenario shall generate a gross turnover of Rs. 200,000 million from a product experiencing zero value and just going waste.

9.3 ENVIRONMENT ORIENTED

9.3.01 The net surplus straw available in the country, is sufficient to produce about 10 million tons of paper. The same quantity of paper if required to be produced by wood, it will require about 28 million tons of wood. On an average, this volume of tree shall require more than 28,000 acres of land on rotational basis. Hence, the concept shall check deforestation to the extent of 28,000 acres every year.

9.3.02 There is a hue and cry world over to save forests in order to check land erosion, flood and balancing of atmospheric cycles. Many countries have started restricting cutting and felling of trees unless the similar quantity of it is planted through different modes of aforestation. India is also following the international trends and hence the country is on lookout for different alternatives. Hence, the endeavour in hand is an eco-friendly step in direction of environment protection.

9.4 FARMER'S INCOME ORIENTED

9.4.01 Introduction and utilization of balers will attract industrial use of straws. Resultantly, the farmers shall recognize commercial vale of straw and hence they will earn an income of about Rs., 3,700 millions from the waste which is just being disposed of at the moment.

9.4.02 The above income earned by the farmers shall be spent on consumption, saving and investment. The income spent on each item shall have a multiplier effect on employment, consumption, saving and investment. As per National Income theory, the money earned by the farmers shall be spent in following ways.

Y	-	Income earned
C	-	Expenses on consumption
S	-	Saving after consumption
I	-	Investment from amount saved

9.4.03 The typical pattern prevailing in the country are :

$$Y100 = C40 + S60 + I30$$

Translated to the total income pattern, the consumption and saving criterion could be analysed as follows:

Y (3700 Million) = C (1480 Million) + S(220 Million) + I (1110 Million)

Which means that out of Rs. 3, 700 million earned, the farmers shall be spending Rs. 1180 million on day to day consumption, Rs. 2220 million shall be saved by them. Out of the saved amount Rs. 1110 million shall be invested in various activities related to development and the rest shall be kept in liquid form to meet the contingencies.

9.4.04 The consumption further attracts payments of sales taxes excise duty, octori etc. going to the exchequers. These clubbed up together (on macro level) comes to about 25% of the total expenditure on consumption. Resultantly, the farmers shall be paying about Rs. 370 million to the exchequers which could help the nation to undertake development activities which shall have further employment generation and multiplier effects.

9.4.05 Even the amount saved and kept in liquid form shall remain with the banks. The deposits with banks shall further add to multiplier effects through distribution theories which is difficult to be estimated and requires a thorough modeling through economic theories.

9.5 EXCHEQUERS INCOME ORIENTED

9.5.01 Production of paper fetches excise duties and cess. These are one of the major incomes to the exchequers to meet its expenses to run the government as well as undertake infrastructural development and provide services to the citizens. The agro based units are dutied at about 5 to 10% of ex-mill price of paper and a cess of 0.125% on an average. Considering the paper prices averaged at Rs. 20,000 per ton, there will be an excise duty earning of approximately Rs. 20,000 million to the exchequers.

9.6 EMPLOYMENT ORIENTED

9.6.01 Paper industry normally generates two types of employment.

i. Direct employment.
ii. Indirect employment.

Direct employment could be defined as the personnel involved directly in production, planning and marketing. The indirect employment is generated through ancilliary and auxiliary activities of the units. For example, the people involved in transportation, loading and unloading of raw materials and finished products could be considered as indirect employment. Similarly, the inhabitants engaged in other activities such as Hotels/Restaurants/Dhaba, Grocery, Vegetable business etc. emerging out of the grown township due to existence of unit, benefit through the indirect employment opportunities.

9.6.02 If the entire surplus straws are used for paper making, a capacity of 10 million tons of paper could be realised. The capacity shall generate a direct employment of about 20 million people and indirect employment of about 60 million people, which in turn shall have further multiplier effects in terms of saving, investment and employment generation.

****

ANNEXURE-I

GALLIGNANI

FAX MESSAGE N. 1493/96
FROM: **GALLIGNANI SpA**

DESIGN

25/10/96
Dir. Comm. DF/FG/sb

To
CHEMPROJECTS

NEW-DELHI - 110017

INDIA

Fax:0091-11-6435289

To the kind attention of MS. SHABNAM PARWEEN

Subject: your fax dtd 18/10/96

With reference to our a.m. fax, we would like first of all to thank you for your renewed interest towards our Company and our products and are pleased to send you herewith enclosed our most competitive offer concerning the models you found suitable for the Indian market.

Pls find here below the general conditions of sale we grant you in case of possible supply.

SUPPLYING TERMS

PRICES:	net in ITL
DELIVERY:	ex our works in Russi, Ravenna, Italy.
PAYMENT:	through irrevocable L/C confirmed by a first class Italian bank and payable at sight of the shipping documents (B/L).
DATE OF SHIPMENT:	date to be fixed upon receipt of firm purchase order specifying number of units according to stock availability.

GALLIGNANI S.p.A. Via Molinaccio, 10 - 48026 Russi (RA) Italia
☎ 0544/589201 - Fax 0544/581222 - ✉ n° 76
Capitale L. [illegible] - [illegible]

Sede Commerciale Divisione Ortofrutta: Via delle Libertà, 37 - 48020 S. Pancrazio di Russi (RA)
☎ 0544/534017 - Fax 0544/534644

GALLIGNANI®

TRANSPORT AND PACKING: transport from our works to your final destination can be made into containers with machines in partly dismantled form and with special support for loading to be charged at cost. Also packing for shipment of a single unit by groupage container can be studied.

OTHER CONDITIONS: as per our general terms and conditions of sale.

VALIDITY: prices quoted are valid until 30/03/97.

We remain at your disposal for any possible info you may require.

Awaiting your comments, we send you in the meanwhile our,

With kindest regards

F. GIANNICO
GALLIGNANI S.p.A.

Tot. pag. 2 + 5

GALLIGNANI S.p.A. Via Molinaccio, 10 - 48026 Russi (RA) Italia
☎ 0544/589201 - Fax 0544/581122 - ✉ n° 76
Capitale L. 6.000.000.000 int. vers. - C.C.I.A.A. n. 28713 Ravenna - Reg. Imprese Trib. Ravenna n. 2067 - C.F./P. IVA 00071920396

Sede Commerciale Divisione Ortofrutta: Via delle Liberté, 37 - 48020 S. Pancrazio di Russi (RA)
☎ 0544/534017 - Fax 0544/534643

PRICE LIST N.104
OCTOBER 1996
1

code no.	2000 - ROLLERS AND BELTS	NET PRICE ITL.
3245008	**2100 "STANDARD" ROUND BALER 1.00x1.25Ø - ROLLERS AND BELTS**	13.464.000
	WITH **"AUTOMEC"** - AUTOMATIC STRING TYING UNIT	
3245009	**2100 "EXTRA" ROUND BALER 1.00x1.25Ø - ROLLERS AND BELTS**	13.968.000
	WITH **"AUTOMEC"** - AUTOMATIC STRING TYING UNIT	
3245311	**2200 ROUND BALER 1.20x1.25Ø - ROLLERS AND BELTS**	15.480.000
	WITH "AUTOLIFE" - AUTOMATIC TWO-STRING TYING UNIT	
3245312	**2200AR ROUND BALER 1.20x1.25Ø - ROLLERS AND BELTS**	17.640.000
	WITH **"AUTOLIFE"** - AUTOMATIC TWO-STRING TYING UNIT	
	AND **"ROTOMEC"** - NET WRAPPING UNIT	
3245313	**2200L "EXTRA" ROUND BALER 1.20x1.25Ø - ROLLERS AND BELTS**	17.784.000
	WITH WIDE PICK-UP - M. 2.00 EQUIPPED WITH 2ND PNEUM. WHEEL	
	AND **"AUTOLIFE"** - AUTOMATIC TWO-STRING TYING UNIT	
3245314	**2200LR "EXTRA" ROUND BALER 1.20x1.25Ø - ROLLERS AND BELTS**	19.944.000
	WITH WIDE PICK-UP - M. 2.00 EQUIPPED WITH 2ND PNEUMATIC WHEEL	
	WITH **"AUTOLIFE"** - AUTOMATIC TWO-STRING TYING UNIT	
	AND **"ROTOMEC"** - NET WRAPPING UNIT	
	standard equipment:	
	TYRES 225/75-15 **FOR 2100 "STANDARD"**	
	TYRES 10.0/75-15 FOR 2100 "EXTRA" AND 2200-2200L	
	WIDE ANGLE CARDAN SHAFT	
	BALE COUNTER	
	ELECTRIC SYSTEM	
	PNEUMATIC PICK-UP WHEEL	
	PICK-UP HYDRAULIC LIFT **(OPTIONAL ONLY FOR 2100)**	
	AUTOMATIC LUBRICATING SYSTEM **FOR "EXTRA"**	

PRICE LIST N.104
OCTOBER 1996
2

code no.	2000 - ATTACHMENTS	NET PRICE ITL.
3246033	BALE KICKER FOR 2100	270.000
3346008	BALE KICKER FOR 2200-2200L	270.000
3346002	WEDGES FOR TAILGATE	36.000
3146129	SHORT CROP BAFFLE PLATE FOR 2100	115.200
3346012	SHORT CROP PIVOTING BAFFLE PLATE FOR 2200	158.400
3346013	SHORT CROP PIVOTING BAFFLE PLATE FOR 2200L	158.400
3146134	3 WAY VALVE (TRACTOR SIDE)	108.000
3246102	KIT FOR 3 ADDITIONAL ROLLERS FOR 2200-2200L	864.000
3246012	AUTOMATIC LUBRICATING SYSTEM FOR 2100	262.800
3246100	AUTOMATIC LUBRICATING SYSTEM FOR 2200	262.800
3246104	NET WRAP "ROTOMEC" WITH ELEC. CONTROL FOR 2200-2200L	2.412.000
3246032	STRAW PRESSER FOR 2100	126.000
3246101	PIVOTING STRAW PRESSER FOR 2200-2200L	164.800
3146090	DRAWBAR LOWERING EXTENTION	108.000
3346028	OVER-RUNNING CLUTCH	165.600
3146044	FINGER WHEEL RAKES FOR2100-2200	316.800
3246001	BIG DIAMETER FINGER WHEEL RAKES FOR 2100-2200	536.400
3146045	2ND PNEUMATIC PICK-UP WHEEL ONLY FOR 2100-2200	144.000
3246024	IN-CAB WARNING DEVICE FOR 2100	158.400
3247006	BRAKING KIT (MECHANICAL) - additional price	676.800
3247010	DRAWBAR EXTENTION WITH TWIN CARDAN SHAFT - additional price	277.200
3147017	BIG-SIZE WHEELS 10.0/75-15 FOR 2100 - additional price	313.200
3247003	PICK-UP HYDRAULIC LIFT FOR 2100 - additional price	176.400

gr 70.000

code no.	1500 / 1600 - SQUARE BALER	NET PRICE ITL.
2445114	1500S SQUARE BALER 36x46 WITH 2/TWINE KNOTTER - 1.08 M. PICK-UP	10.260.000
2445113	1600S SQUARE BALER 36x46 WITH 2/TWINE KNOTTER - 1.30 M. PICK-UP	10.512.000
	standard equipment:	
	TYRES 205/75-15 LEFT - 165.14 RIGHT	
	CARDAN SHAFT	
	recommended attachments:	
0646110	BALE COUNTER	57.600
2446053	ELECTRIC SYSTEM	147.600
	attachments:	
2446014	BRAKING KIT	529.200
2446011	SWIVEL RING HITCH	57.600
2446068	SHORT CROP BAFFLE PLATE **FOR 1500**	108.000
2446031	SHORT CROP BAFFLE PLATE **FOR 1600**	108.000
0646101	AUTOMATIC LUBRICATING SYSTEM FOR 2/TWINE KNOTTER	298.800
2446039	DRAWBAR EXTENTION	104.400
0646106	IRON BOTTOM ROLLER	165.600
2446032	REAR RUBBER WHEEL	378.000
2446034	RUBBER PICK-UP WHEEL	86.400
2446035	PNEUMATIC PICK-UP WHEEL	144.000
2446036	LEFT SUPPORT SKID	280.800
2446048	PICK-UP HYDRAULIC LIFT	280.800
2446070	DRAWBAR HYDRAULIC ADJUSTMENT	511.200
2446049	DRAWBAR MECHANICAL ADJUSTMENT	122.400
0447001	WIDE ANGLE CARDAN SHAFT - **additional price**	205.200
2447002	SPECIAL WHEELS 10.0/80-12 / 7.00-12 - **additional price**	298.800
2447003	DRAWBAR AND TWIN CARDAN SHAFT - **additional price**	259.200
2446063	SPECIAL DRAWBAR MECHANICAL ADJUSTMENT FOR CODE NO. 2447003	129.600
1246012	SWIVEL RING HITCH FOR CODE NO. 2447003	57.600

PRICE LIST N.104
OCTOBER 1996
4

code no.	2690 / 3690 - SQUARE BALER	NET PRICE ITL.
2445212	2690S SQUARE BALER 36x46 WITH 2/TWINE KNOTTER - 1.55 M. PICK-UP	11.088.000
2445214	3690S SQUARE BALER 36x46 WITH 2/TWINE KNOTTER - 1.70 M. PICK-UP	11.304.000
2445227	3690F SQUARE BALER 36x46 - 2/IRON WIRE TWISTER - 1.70 M. PICK-UP	12.384.000
	standard equipment:	
	TYRES 205.75-15 LEFT - 165.14 RIGHT	
	CARDAN SHAFT	
	recommended attachments:	
0646110	BALE COUNTER	57.600
2446053	ELECTRIC SYSTEM	147.600
	attachments:	
2446014	BRAKING KIT	529.200
2446011	SWIVEL RING HITCH	57.600
1546002	SHORT CROP BAFFLE PLATE FOR 2690	108.000
2446052	SHORT CROP BAFFLE PLATE FOR 3690	108.000
0646101	AUTOMATIC LUBRICATING SYSTEM FOR 2/TWINE KNOTTER	298.800
0646102	AUTOMATIC LUBRICATING SYSTEM FOR 2/WIRE TWISTER	298.800
2446039	DRAWBAR EXTENTION	104.400
0646106	IRON BOTTOM ROLLER	165.600
2446032	REAR RUBBER WHEEL	070.000
2446034	RUBBER PICK-UP WHEEL	86.400
2446035	PNEUMATIC PICK-UP WHEEL	144.000
2446036	LEFT SUPPORT SKID	280.800
2446048	PICK-UP HYDRAULIC LIFT	280.800
2446070	DRAWBAR HYDRAULIC ADJUSTMENT	511.200
2446049	DRAWBAR MECHANICAL ADJUSTMENT	122.400
0447001	WIDE ANGLE CARDAN SHAFT - additional price	205.200
2447002	SPECIAL WHEELS 10.0/80-12 / 7.00-12 - additional price	298.800
2447003	DRAWBAR AND TWIN CARDAN SHAFT - additional price	259.200
2446063	SPECIAL DRAWBAR MECHANICAL ADJUSTMENT FOR CODE NO. 2447003	129.600
1246012	SWIVEL RING HITCH FOR CODE NO. 2447003	57.600

code no.	**5190 - *SQUARE BALER***	NET PRICE ITL.
0645110	**5190S SQUARE BALER 36x46 WITH 2/TWINE KNOTTER - 1.55 M. PICK-UP**	13.392.000
0645125	**5190F SQUARE BALER 36x46 - 2/IRON WIRE TWISTER - 1.55 M. PICK-UP**	14.472.000
0645325	**5190F3 SQUARE BALER 36x46 - 3/IRON WIRE TWISTER - 1.55 M. PICK-UP**	15.948.000
0646044	TPP STRAW CHOPPER **FOR 5190F3**	6.336.000
0646046	TPP "EXTRA" STRAW CHOPPER (PF) **FOR 5190F3**	7.056.000
	standard equipment:	
	TYRES 10.0/75-15 LEFT - 6.00-16 RIGHT	
	TWIN CARDAN SHAFT	
	recommended attachments:	
0646110	BALE COUNTER	57.600
0646012	ELECTRIC SYSTEM	147.600
	attachments:	
0646026	BRAKING KIT	529.200
1246012	SWIVEL RING HITCH	57.600
1546002	SHORT CROP BAFFLE PLATE	108.000
0646101	AUTOMATIC LUBRICATING SYSTEM FOR 2/TWINE KNOTTER	298.800
0646102	AUTOMATIC LUBRICATING SYSTEM FOR 2/WIRE TWISTER	298.800
0646108	IRON BOTTOM ROLLER	165.600
0646098	REAR RUBBER WHEEL	500.400
2446034	RUBBER PICK-UP WHEEL	86.400
0646083	RIGHT SUPPORT SKID	198.000
0646079	LEFT SUPPORT SKID	277.200
0646112	PICK-UP HYDRAULIC LIFT (NOT AVAILABLE WITH TPP)	309.600
1946016	DRAWBAR HYDRAULIC ADJUSTMENT	475.200

ANNEXURE II

Revised/Rebate
& 30/11

JOHN DEERE EXPORT
A DIVISION OF DEERE & CO

STEUBENSTRASSE 36-42
68140 MANNHEIM
WEST GERMANY

PROFORMA-INVOICE
FACTURE-PROFORMA
NO. 542 10059
DATE : 21-10-96-

= YOUR TELEFAX INQUIRY
DATED 15 OCTOBER 1996 =

TO : CHEMPROJECTS DESIGN&ENGG PVT
17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

WE OFFER:

1 (ONE) NEW JOHN DEERE MODEL 359 TWINE BALER
ORIGIN : FRANCE (EUROPEAN COMMUNITY)

DELIVERY SUBJECT TO COMPLIANCE WITH GOVERNMENT RULES AND REGULATIONS OF SUPPLYING COUNTRIES IN EFFECT AT TIME OF SHIPMENT.

BASE EQUIPMENT:

BASE EQUIPMENT,-BALE CHAMBER 36 X 46 CM,-PICK-UP 1.56 M INSIDE AND 1.75 M OUTSIDE WIDTH,-LONGER FEEDING AUGER W/DEFLECTOR, ADJUSTABLE FEEDER FORK,-PLUNGERHEAD SPEED: 92 STROKES P.M., REAR REFLECTORS,-MULTILUB GREASING SYSTEM IN KNOTTER AREA. TRIPLE TWINE HOLDER,-INTEGRATED LOADING HOOKS,-MECHANICAL TONGUE POSITIONING,-SIDE HAY RETAINERS,-BALE COUNTER,-SPECIAL SHIELDING.

IN ADDITION OR SUBSTITUTING, RESPECTIVELY, FOLLOWING ITEMS:

0359C	359 TWINE BALER
2007	WHEELS LH 10.00/75 X 15.3, RH 7.00 X 12
3000	4 BALLS TWINE BOX
3514	STANDARD LENGTH POWERLINE, 540 RPM
4150	ENGLISH/FRENCH/GERMAN DECALS
5101	BALL JOINT HITCH
6274	ENGLISH OPERATOR'S MANUAL
7582	MECHANICAL PICK-UP LIFT
7083	MECHANICAL BALE TENSION
9027	RAILCAR SHIPMENT
9075	TONGUE REMOVED
9012	BALE COUNTER
9206	PARTS CATALOG

PRICE FREE CARRIER OUR FACTORY ONE UNIT:	FF	59.935.00
EXPENSES UP TO FREE CARRIER PORT		7.350.00

---02-

JOHN DEERE EXPORT
A DIVISION OF DEERE & CO

STEUBENSTRASSE 36-42
63140 MANNHEIM
WEST GERMANY

PROFORMA-INVOICE
FACTURE-PROFORMA
NO. 542 10059
DATE : 21 10 96

TO : CHEMPROJECTS DESIGN&ENGG PVT
17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

OCEAN FREIGHT	8.300.00
CPT, CARRIAGE PAID TO PORT.BOMBAY.....	75,585.00
INSURANCE	370.00
CIP, CARRIAGE & INSUR. PAID TO PORT.BOMBAY.... FF	75.955.00

VALIDITY : OFFER VALID FOR 90 DAYS FOR RECEIPT OF FINANCIALLY COVERED FIRM ORDER.

DELIVERY EX FACTORY : TENTATIVELY 120 DAYS AFTER RECEIPT OF FIRM ORDER AND AVAILABILITY OF LETTER OF CREDIT ACCEPTABLE TO JOHN DEERE EXPORT.

PAYMENT TERMS: IRREVOCABLE AND CONFIRMED LETTER OF CREDIT, PAYABLE AT SIGHT, AND ACCEPTABLE TO JOHN DEERE EXPORT.

OUR DELIVERY TERMS ARE BASED ON INCOTERMS 1990

ALL EXPENSES SHOWN HERE OTHER THAN THE MERCHANDISE VALUE ARE ESTIMATED ONLY AND INDICATED FOR YOUR CONVENIENCE AND AS SUCH WITHOUT OBLIGATION TO US.

PHONE : 0621-81041
CABLE : DEEREXPORT MANNHEIM
TELEX : 04-63233
BANKERS : DEUTSCHE BANK AG, MANNHEIM
DRESDNER BANK AG, MANNHEIM

JOHN DEERE EXPORT
A DIVISION OF DEERE & COMPANY

JOHN DEERE EXPORT
A DIVISION OF DEERE & CO

STEUBENSTRASSE 36-42
68140 MANNHEIM
WEST GERMANY

PROFORMA-INVOICE
FACTURE-PROFORMA
NO. 542 10058
DATE : 21-10-96-

= YOUR TELEFAX INQUIRY
DATED 15 OCTOBER 1996 =

TO : CHEMPROJECTS DESIGN&ENGG PVT
17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

WE OFFER:

1 (ONE) NEW JOHN DEERE MODEL 570 ROUND BALER
ORIGIN : FRANCE (EUROPEAN COMMUNITY)

DELIVERY SUBJECT TO COMPLIANCE WITH GOVERNMENT RULES AND REGULATIONS OF SUPPLYING COUNTRIES IN EFFECT AT TIME OF SHIPMENT

BASE EQUIPMENT:

BASE EQUIPMENT,-1.17M X 0.60M TO 1.30M DIAMETER BALE -ADJ. BALE DENSITY CONTROL VALVE,-MAIN TWINE BOX, BALE TWINE STORAGE (2LH - 3RH),-DOUBLE TYING ARM,-SAFETY FRONT AND REAR SHIELD,-BALE SHAPE INDICATOR (DEPENDS ON MONITOR),-BALE COUNTER (DEPENDS ON MONITOR),-MECHANICAL BALE DIAMETER INDICATOR,-SIX 178MM DIAMOND TREAD,-FRICTION SURF. RUBBER BELTS,-STARTER ROLL W/ STEEL BARS INSTALLED,-RUBBER COATED BARS - NOT INSTALLED,-KNIFE TYPE SCRAPER,-STAGGERED ROLL #13, SMOOTH TYPE,-BELT SLACK CONTROL, TORSION BAR, ROLL #9 W/ STRIPPERS,-MULTIPOSITION TONGUE, COMPRESSOR RODS,-SCREW TYPE JACK STAND,-MECHANICAL PICK UP LIFT, SIDE FLARE CROP GUIDES,-"GORO" BELT LACINGS,-SAFETY SHIELD (NOT REQUIRED W/ "NET WRAPPING"),-(REQUIRES ONE REMOTE TRACTOR OUTLET DOUBLE ACTING).

IN ADDITION OR SUBSTITUTING, RESPECTIVELY, FOLLOWING ITEMS:

0570C 570 ROUND BALER

1084 HITCH W/ BALL JOINT
1148 STANDARD PICK-UP (1.41M)
1504 POWER LINE W/ SHEARBOLT
2012 WHEELS 10.0/75 X 15.3, 6PR - NOT W/ CODE
4004 MANUAL TWINE CONTROL SWITCH W/ ELS
- NOT COMPATIBLE W/ NET WRAPPING
- TYING ARM CODE 8527 IS ADDED AUTOMATICALLY
3483 OM ENGLISH

JOHN DEERE EXPORT
A DIVISION OF DEERE & CO

TEUBENSTRASSE 36-42
[illegible]0 MANNHEIM
WEST GERMANY

PROFORMA-INVOICE
PICTURE-PROFORMA
NO. 542 10058
DATE : 21 10 96

CHEMPROJECTS DESIGN&ENGG PVT
17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

[illegible]7 RAIL SHIPMENT
[illegible]66 PARTS CALATOGUE

PRICE FREE CARRIER OUR FACTORY ONE UNIT:	FF	77,272.00
EXPENSES UP TO FREE CARRIER PORT		7,350.00
OCEAN FREIGHT		9,400.00
CPT, CARRIAGE PAID TO PORT..BOMBAY.....		94,022.00
INSURANCE		461.00
CIP, CARRIAGE & INSUR. PAID TO PORT..BOMBAY...	FF	94,483.00

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17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

WE OFFER:

1 (ONE) NEW JOHN DEERE MODEL 359 TWINE BALER
ORIGIN : FRANCE (EUROPEAN COMMUNITY)

DELIVERY SUBJECT TO COMPLIANCE WITH GOVERNMENT RULES AND REGULATIONS OF SUPPLYING COUNTRIES IN EFFECT AT TIME OF SHIPMENT.

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IN ADDITION OR SUBSTITUTING, RESPECTIVELY, FOLLOWING ITEMS:

0359C	359 TWINE BALER		
2007	WHEELS LH 10.00/75 X 15.3, RH 7.00 X 12		
3000	4 BALLS TWINE BOX		
3514	STANDARD LENGTH POWERLINE, 540 RPM		
4150	ENGLISH/FRENCH/GERMAN DECALS		
5101	BALL JOINT HITCH		
6274	ENGLISH OPERATOR'S MANUAL		
7582	MECHANICAL PICK-UP LIFT		
7083	MECHANICAL BALE TENSION		
9027	RAILCAR SHIPMENT		
9075	TONGUE REMOVED		
9012	BALE COUNTER		
9206	PARTS CATALOG		
	PRICE FREE CARRIER OUR FACTORY ONE UNIT:	FF	59,235.00
	EXPENSES UP TO FREE CARRIER PORT		7,350.00

JOHN DEERE EXPORT
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STEUBENSTRASSE 36-42
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OCEAN FREIGHT		8,300.00
CPT, CARRIAGE PAID TO PORT.BOMBAY.....		75.585.00
INSURANCE		370.00
CIP. CARRIAGE & INSUR. PAID TO PORT.BOMBAY....	FF	75,955.00

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JOHN DEERE EXPORT
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STEUBENSTRASSE 36-42
68140 MANNHEIM
WEST GERMANY

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NO. 542 10058
DATE : 21-10-96-

= YOUR TELEFAX INQUIRY
DATED 15 OCTOBER 199

TO : CHEMPROJECTS DESIGN&ENGG PVT
17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

WE OFFER:

1 (ONE) NEW JOHN DEERE MODEL 570 ROUND BALER
ORIGIN : FRANCE (EUROPEAN COMMUNITY)

DELIVERY SUBJECT TO COMPLIANCE WITH GOVERNMENT RULES AND REGULATION OF SUPPLYING COUNTRIES IN EFFECT AT TIME OF SHIPMENT

BASE EQUIPMENT:

BASE EQUIPMENT,-1.17M X 0.60M TO 1.30M DIAMETER BALE -ADJ. BALE DENSITY CONTROL VALVE,-MAIN TWINE BOX. BALE TWINE STORAGE (2LH + 3RH),-DOUBLE TYING ARM,-SAFETY FRONT AND REAR SHIELD.-BALE SHAPE INDICATOR (DEPENDS ON MONITOR),-BALE COUNTER (DEPENDS ON MONITOR),-MECHANICAL BALE DIAMETER INDICATOR,-SIX 178MM DIAMOND TREAD,-FRICTION SURF. RUBBER BELTS,-STARTER ROLL W/ STEEL BARS INSTALLED,-RUBBER COATED BARS - NOT INSTALLED,-KNIFE TYPE SCRAPER,-STAGGERED ROLL #13, SMOOTH TYPE,-BELT SLACK CONTROL, TORSION BAR,-ROLL #9 W/ STRIPPERS,-MULTIPOSITION TONGUE, COMPRESSOR RODS,-SCREW TYPE JACK STAND,-MECHANICAL PICK UP LIFT, SIDE FLARE CROP GUIDES,-"GORO" BELT LACINGS,-SAFETY SHIELD (NOT REQUIRED W/ "NET WRAPPING"),-(REQUIRES ONE REMOTE TRACTOR OUTLET DOUBLE ACTING).

IN ADDITION OR SUBSTITUTING, RESPECTIVELY, FOLLOWING ITEMS:

0570C 570 ROUND BALER

1084 HITCH W/ BALL JOINT
1148 STANDARD PICK-UP (1.41M)
1504 POWER LINE W/ SHEARBOLT
2012 WHEELS 10.0/75 X 15.3, 6PR - NOT W/ CODE
4004 MANUAL TWINE CONTROL SWITCH W/ ELS
- NOT COMPATIBLE W/ NET WRAPPING
- TYING ARM CODE 8527 IS ADDED AUTOMATICALLY
3483 OM ENGLISH

---02-

JOHN DEERE EXPORT
A DIVISION OF DEERE & CO

STEUBENSTRASSE 36-42
68140 MANNHEIM
WEST GERMANY

PROFORMA-INVOICE
FACTURE-PROFORMA
NO. 542 10058
DATE : 21 10 96

TO : CHEMPROJECTS DESIGN&ENGG PVT
17, PANCHSHILA SHOPPING CENTER
NEW DELHI - 110017
INDIA

9027 RAIL SHIPMENT
9866 PARTS CALATOGUE

PRICE FREE CARRIER OUR FACTORY ONE UNIT:	FF	77,272.00
EXPENSES UP TO FREE CARRIER PORT		7,350.00
OCEAN FREIGHT		9,400.00
CPT, CARRIAGE PAID TO PORT..BOMBAY.....		94,022.00
INSURANCE		461.00
CIP, CARRIAGE & INSUR. PAID TO PORT..BOMBAY...	FF	94,483.00

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JOHN DEERE EXPORT
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STEUBENSTRASSE 36-42
68140 MANNHEIM
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BANKERS : DEUTSCHE BANK AG, MANNHEIM
DRESDNER BANK AG, MANNHEIM

JOHN DEERE EXPORT
A DIVISION OF DEERE & COMPANY

ANNEXURE - III

NEW HOLLAND

Fax : 6495289

18 June, 1997

M/S Chemprojects Design and Engineering (P) Ltd.
17, GOPALDEEP, nd floor
Panchshila Shopping Centre
New Delhi
110 017

Attn. : Mr. Dhananjay Kumar

Dear Sir,

New Holland Balers

This has reference to the discussions we had yesterday in our office.

We are pleased to enclose herewith our offer for New Holland Baler Mod. 1565 T

Please note following :

1. **We do not recommend round balers as**
   - Field sizes in India are mainly very small and in small fields movement out of large balers would be very difficult
   - It would require a bigger tractor of 75 hp
   - Transportation on roads narrow village roads would be difficult
   - You would require a pick-up crane for loading
   - Efficiency would be very low on small fields as you would run out of straw due to insufficient straw availability to utilize extra capacity
2. We are enclosing herewith an analysis " Estimated operating cost of round balers"
3. Also find enclosed analysis on "Estimated operating cost of NH 565 baler"-this is a rectangular **baler and we recommend this baler** as it is ideally suited for our working conditions
4. This baler is tractor PTO driven
5. As discussed with you, we have done number of successful trials with this baler
6. We are ready to demonstrate this baler in our farm at Ballabgarh - Sohna road
7. Also trials can be conducted any of nearby paper factory

We look forward to a fruit-full business association with your organization.

Thanking You.

Yours Sincerely,

A. K. GHOSH
Manager- Product Marketing

New Holland Tractors (India) Private Limited

210, Okhla Industrial Area-III
New Delhi- 110 020
Tel.: 011-6932207/08/10/12/13
Fax: 011 6932208

Registered Office :
C/o Little & Co
Central Bank Building
Mahatma Gandhi Road
Bombay-400 023

MODEL 565-T TWINE-TIE BALER
36 X 46 CM BALES (14 X 18 IN), ADJUSTABLE LENGTH
1 .80 METRE PICK - UP
2 - JOINT PTO WITH SHORT TONGUE
HITCH & JACK
TRIPLE PURPOSE BALE CHUTE

Price – delivered Delhi including Customs duty & Excise **F s.454300**

Price exludes Twine & Spare parts

Sales Tax not included

round

Estimated operating cost of Round Baler

			Rate	Annual Cost	
Cost of Baler	Rs.	600,000			
Interest			20%	120,000	Should be 5%
Cost of tractor 75hp (4 months)		250,000			Only 120 days use with baler
Interest			20%	50,000	
Operational Days			120		Should be more if stationery baling of pa straw is possible
Operational hours @ 10/day			1200		
Bales per hour			7		Maximum output of baler is 35 bales per hour, however due to small field, low stra availability and operator efficiency level v do not expect more than 7per hour (See r
Bale weight (kg)			320		
Bales per year			8400		
Tonnes per year			2688		
Fuel consumption (litres)			4.5		
Fuel per year			5400		
Cost of fuel			9	48,600	
Driver			2000	8,000	
Repair/maintenance (baler)			5%	30,000	
Repair/maintenance (tractor)			5%	12,500	
Twine @ 800 per pair for 80 bales			10	84,000	Imported sisal (local twine if available sho halve this cost
Annual running cost				353,100	
Cost per tonne				131	
Crane hire @ 400/hr			3	1,200	
Cost per tonne .				54	
Total cost per tonne				**185**	

Bales per hour

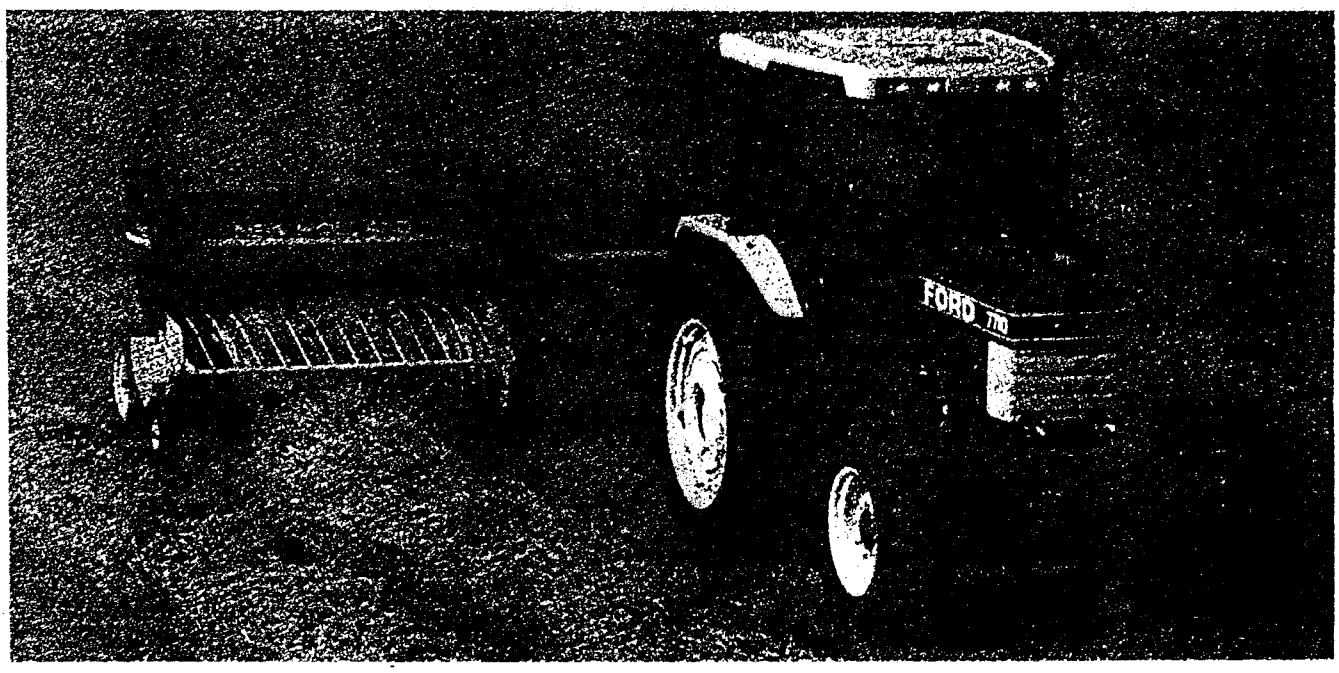
Maximum baler output		35	
Adjustments, repairs, maintenanc	10%	3.5	Bale density, blockages, greasing, twine beakage etc
Turning, manoevering	30%	10.5	Low efficiency due to small field size
Changing fields	10%	3.5	This allows only one hour per day for travelling between site
Operator efficiency	20%	7	Driver must be well trained to operate at 80% efficiency
Capacity utilisation	10%	3.5	This high capacity machine will not find sufficient material to operate at full capacity
		7	

Estimated operating cost of NH 565 Baler

			Rate	Annual Cost	
Cost of Baler	Rs.	454,300			
Interest			20%	90,860	Should be 15%
Cost of tractor (4 months)	Rs	100,000			Only 120 days use with baler
Interest			20%	20,000	
Operational Days			120		Should be more if stationery baling of p straw is possible
Operational hours @ 10/day			1200		
Bales per hour			75		Maximum output of baler is 250 bales p hour, however due to small field, low sti availability and operator efficiency level do not expect more than 75 per hour
Bale weight (kg)			25		
Bales per year			90000		
Tonnes per year			2250		
Fuel consumption (litres)			4.5		
Fuel per year			5400		
Cost of fuel			9	48,600	
Driver			2000	8,000	
Repair/maintenance (baler)			5%	22,715	
Repair/maintenance (tractor)			5%	5,000	
Twine @ 800 per pair					
for 600 bales			1.33	119,700	Importec sisal (local twine if available sh halve this cost
Annual running cost				314,875	
Cost per tonne				140	

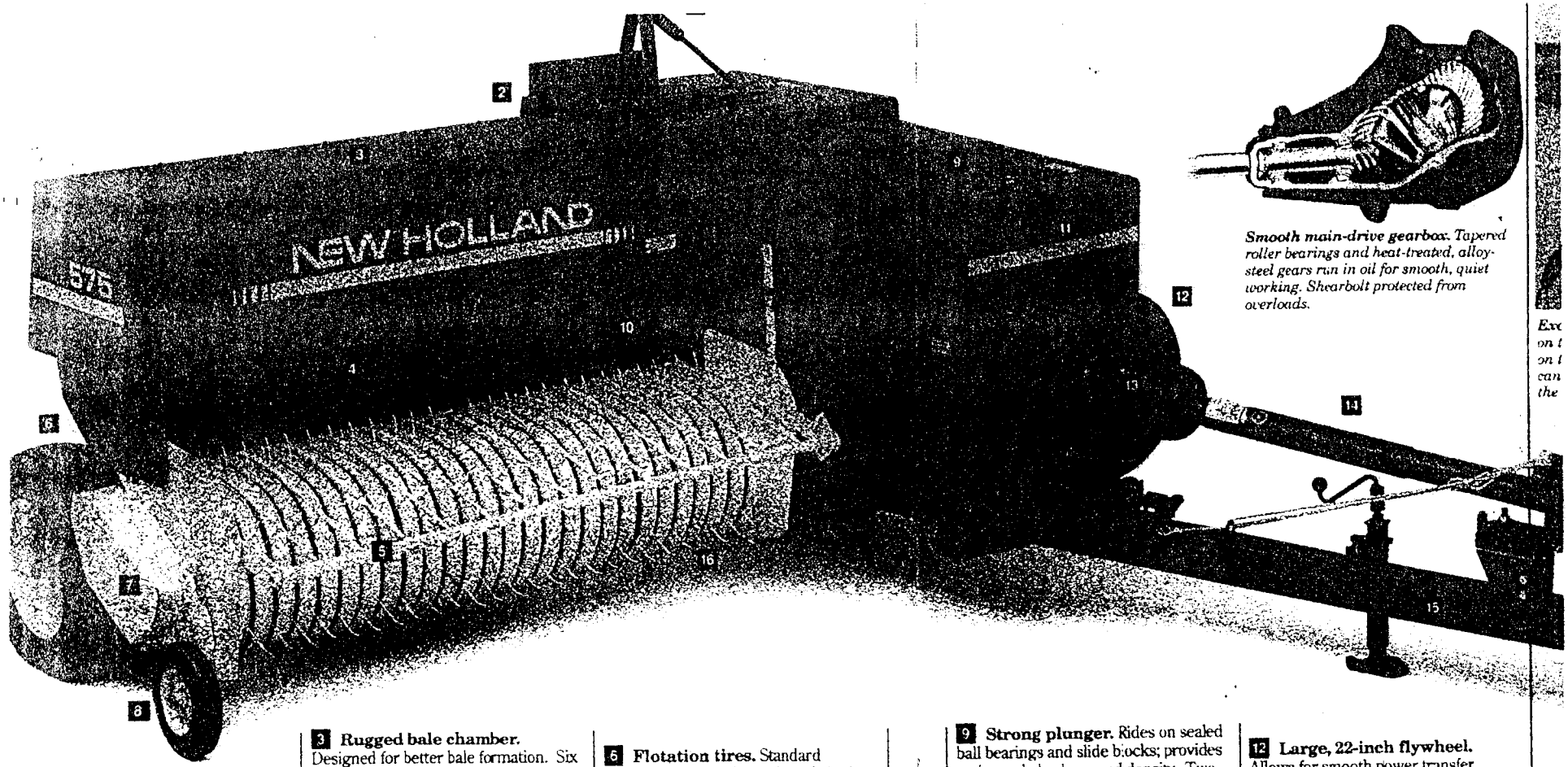
Bales per hour

Maximum baler output		250	
Adjustments, repairs, maintenanc	10%	25	Bale density, blockages, greasing, twine beakage etc
Turning, manoevering	30%	75	Low efficiency due to small field size
Changing fields	10%	25	This allows only one hour per day for travelling between sit
Operator efficiency	20%	50	Drive r must be well trained to operate at 80% efficiency
		75	



MODEL	585	570	575
Bale Size:			
Cross section	14×18 in. (36×46 cm)	14×18 in. (36×46 cm)	14×18 in. (36×46 cm)
Length	Adjustable, 12 to 52 in. (31 to 132 cm)	Adjustable, 12 to 52 in. (31 to 132 cm)	Adjustable, 12 to 52 in. (31 to 132 cm)
Super-Sweep Pickup:			
Width inside	65 in. (1.65 m)	65 in. (1.65 m)	75 in. (1.9 m)
Width on flare	70 in. (1.8 m)	70 in. (1.8 m)	80 in. (2 m)
Number of teeth	88 on four tooth bars	132 on six tooth bars	156 on six tooth bars
Floating windguard	Eight rods	Eight rods	Thirteen rods
Drive	V-belt to roller chain to "lost motion" reel drive		
Gauge wheel	3.00×12; semi-pneumatic	3.00×12; semi-pneumatic	3.00×12; semi-pneumatic
Rotary Feeding System:			
Type	—	Packer fork in combination with two paired rotors	Packer fork in combination with three paired rotors
Drive	—	Chain from main drive shaft; sealed ball bearings on all shafts	
Flow-Action Feeding System:			
Type	Six feeder tines on a moving finger bar	—	—
Drive	Chain; sealed ball bearings		
Feed Opening	283 sq. in. (1826 cm²)	283 sq. in. (1826 cm²)	283 sq. in. (1826 cm²)
Plunger:			
Stroke length	30 in. (76.2 cm)	30 in. (76.2 cm)	30 in. (76.2 cm)
Speed (540 rpm)	79 SPM	93 SPM	93 SPM
Construction	High-strength steel throughout; modified extension is built into the plunger face, eliminating the need for bolt-on extensions		
Tying Mechanisms:			
Type	Knotter or twister	Knotter or twister	Knotter or twister (heavy-duty)
Protection	Shearbolt	Shearbolt	Shearbolt
Capacity (twine)	Four balls	Six balls	Six balls
(wire)	Four coils	Four coils	Four coils
Main Drive:			
Flywheel diameter	22 in. (56 cm)	22 in. (56 cm)	22 in (56 cm)
PTO	Two- or three-joint	Three-joint	Three-joint
Protection	Shearbolt, overrunning and slip clutches	Shearbolt, overrunning and slip clutches	Shearbolt, and overrunning slip clutches
Gearbox	Hypoid with tapered roller bearings; heat-treated alloy steel running in oil		
Tires:			
Flotation (right)	25×7.50-15, 6 PR	25×7.50-15, 6 PR	27×9.50-15, 6 PR
(left)	27×9.50-15, 6 PR	11.00L×14, 6 PR	31×13.50-15, 6 PR
Dimensions:			
Height (max.)	58 in. (146 cm)	70 in. (178 cm)	71 in. (180 cm)
Width	108 in. (275 cm)	110 in. (279 cm)	120 in. (304 cm)
Length:			
With 2-joint PTO and quarter-turn bale chute	209 in. (530 cm)	—	—
With 3-joint PTO and quarter-turn bale chute	240 in. (610 cm)	247 in. (626 cm)	247 in. (626 cm)
Weight (approximate):			
With two-joint PTO, twine version	3020 lb. (1370 kg)	—	—
With three-joint PTO, twine version	3137 lb. (1423 kg)	3393 lb. (1540 kg)	3570 lb. (1619 kg)
With three-joint PTO, wire version	3273 lb. (1485 kg)	3529 lb. (1601 kg)	3706 lb. (1681 kg)
Recommended Transport Speed	20 mph (32 km/h)	20 mph (32 km/h)	20 mph (32 km/h)
Tractor Requirement*			
Horsepower (min.)	35 hp (26 kW)	62 hp (45 kW)	75 hp (56 kW)
Tractor weight must be greater than baler weight; excludes bale thrower.			
Options	565: two- or three-joint PTO (Cat. 3 or 4); 565 w/o PTO and slipclutch; hydraulic pickup lift; hydraulic tongue swing; needle slot baffle kit; auxiliary lights; safety chain; wagon hitch and bale-loading chute; triple-purpose chute; quarter-turn bale chute; hydraformatic bale tension; ball hitch (575 only); extra-flotation tires on 570 twine baler (27×9.50-15, 6 PR right, 31×13.50-15, 6 PR left).		

Design, materials and/or specifications are subject to change without notice and without liability therefor.
Specifications are applicable to units sold in Canada, the United States, its territories and possessions, and may vary outside these areas.



Smooth main-drive gearbox. Tapered roller bearings and heat-treated, alloy-steel gears run in oil for smooth, quiet working. Shearbolt protected from overloads.

1 Adjustable packer fork. Part of the feeding system on the "570", "575" and "580". Easily adjustable to handle various crops for consistent bale formation.

2 Gear-driven knotters or twisters. Your choice. Both are known for their "thousands of bales without a miss." now, gear drives make them easier to keep in time.

3 Rugged bale chamber. Designed for better bale formation. Six hay dogs hold charges in place for firm, quality bales.

4 High-capacity feeding systems. The rotary feeder is standard on the "570", "575" and "580". The time-proven Flow-Action® feeder on the "565". Both systems are adjustable to work in varying crops, from alfalfa to slippery grasses.

5 Floating windguard. Gets the windrow under control and forms it into a smooth mat for positive feeding.

6 Flotation tires. Standard equipment. Smooth out the ride in the roughest fields, while taking it easy on tender alfalfa regrowth.

7 Belt-driven pickup. Acts as a slip clutch to prevent overloads. The pickup can be backed up without damaging the pickup teeth ("lost motion drive").

8 Pickup gauge wheel. Standard equipment. Compensates for uneven field conditions as it protects pickup teeth.

9 Strong plunger. Rides on sealed ball bearings and slide blocks; provides optimum bale shape and density. Two of the bearings and one plunger rail are adjustable for maintaining proper alignment.

10 Large feed opening. Large enough to handle the big capacity pickup and feeder.

11 Fast plunger speed; long plunger stroke. Thirty-inch stroke for all balers; speed is set to maximize baler capacity (from 79 to 93 SPM, depending on the model).

12 Large, 22-inch flywheel. Allows for smooth power transfer.

13 Slip clutch protection. Three-disk clutch on the "580" and "575", two disk on the "570" and "565", along with overrunning drives, gives gentle load engagement, long life and greater load capacity.

14 Large driveline. Category 6 on the "580", "575", and "570", Category 3 or 4 on the "565". Lets you push more power into the baler for high-capacity baling.

EXHIBIT – 1

DR DISTRICTS WITH NET AVAILABILITY OF
E THAN 1.0 LAKH TON OF RICE / WHEAT STRAW