Assessment of Post-harvest Losses of Agri-commodities – Methodologies and Indian Experiences

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BACKGROUND

1. On the recommendation of Parliamentary Standing Committee on Agriculture (PSCA), the 1st study was conducted by ICAR-AICRP on PHET for estimating Harvest & Post-Harvest Losses of 45 crops/commodities in 2005-07 at National level. Results were submitted to PSCA and the approved report was published in September 2012

2. The second study was sponsored by MoFPI to assess the change in magnitude of losses, in Feb 2012 as **repeat** study, and report was submitted in May 2015.

3. In 2021-22 MoFPI got conducted third study for 54 crops and commodities to reassess the extent of post-harvest losses across India by NABCON a subsidiary of NABARD.

OBJECTIVES

- To carry out a systematic quantitative assessment of the extent of harvest and post-harvest losses of all major crops representing cereals, millets, pulses, oilseeds, fruit, vegetables, plantation crops and spices & condiments as well as livestock produce comprising meat, fish, egg and milk at the national level covering 14 agro-climatic zones (in first two studies and all 15 zones in third study.
- To estimate the losses, starting from harvesting, at all post-harvest on-farm operations, transportation, storage and distribution in various marketing channels.

- To evolve/refine appropriate methodology and measurement techniques for the above estimation, viz. schedules for all crops and livestock produce selected for collection of data by enquiry and by observation , suitable software for computerized data entry, and statistical procedure to give a single estimate from the two sets of data collected (enquiry and observation)

- To identify the specific crop/ commodity as well as the specific unit operation inducing significant losses in order to prioritize the points of remedial intervention

Definition of Losses

Reduction in weight of usable portion available for human consumption" (reduction in weight due to drying/moisture loss, kitchen and table losses etc. were not included)

The losses such as quality loss, food value loss, loss of goodwill or reputation, seed vigor loss, etc. are not quantitative in nature and hence were not considered in these studies

Major Assumptions

1. Only the quantitative harvest & post-harvest losses were assessed.
2. The data for harvest and post-harvest losses for the selected 45 (2005-06, 2012-14) & 54 (2021-22) commodities were collected for full crop cycles.
3. Contractual persons (Field Investigators) were engaged and trained for collecting the data for computing the losses.
4. Necessary Data Entry software and statistical software for Analysis were provided by the ICAR-Indian Agricultural Statistics Research Institute (IASRI), New Delhi.

Commodities' Selection

Cereals:	Paddy, Wheat, Maize, Bajra, Sorghum	***(05, 05)***
Pulses:	Pigeonpea, Chickpea, Black gram, Green gram	***(04, 04)***
Oilseeds:	Mustard, Cottonseed, Soybean, Safflower, Sunflower, Groundnut	***(06, 06)***
Fruits:	Apple, Banana, Citrus, Grapes, Guava, Mango, Papaya, Sapota (Pineapple, Pomegranate, Muskmelon)	***(08, 11)***
Vegetables:	Cabbage, Cauliflower, Green pea, Mushroom, Onion, Potato, Tomato, Tapioca (Bottle gourd, Brinjal, Beans, Reddish, Capsicum, Okra)	***(08, 14)***
Cash Crops/:	Arecanut, Black pepper, Cashew, Chilli, Coconut, Coriander, Sugarcane, Turmeric	***(08, 08)***
Other Commodities:	Egg, Inland fish, Marine fish, Meat, Poultry meat, Milk,	***(06, 06)***

Total No of crops and commodities 45 in 2012-13 and 54 in 2021-22

Farm Operations and channels covered

1. Harvesting
2. Collection
3. Sorting/ grading
4. Threshing/ Dehusking
5. Winnowing/ cleaning
6. Drying
7. Packaging
8. Transportation
9. Storage at farm/ household level
10. Storage at godown/ warehouse/ cold stores
11. Storage at wholesale level
12. Storage at retailer level
13. Storage at processing units

Sampling Technique

The sampling methodology adopted for the survey is based on standard technique of *stratified multistage random sampling*

Sampling Design

Agro-Climate Zone (14, 15)

Districts (120, 292)

Blocks (2 from each District)

Villages (5 from each Block)

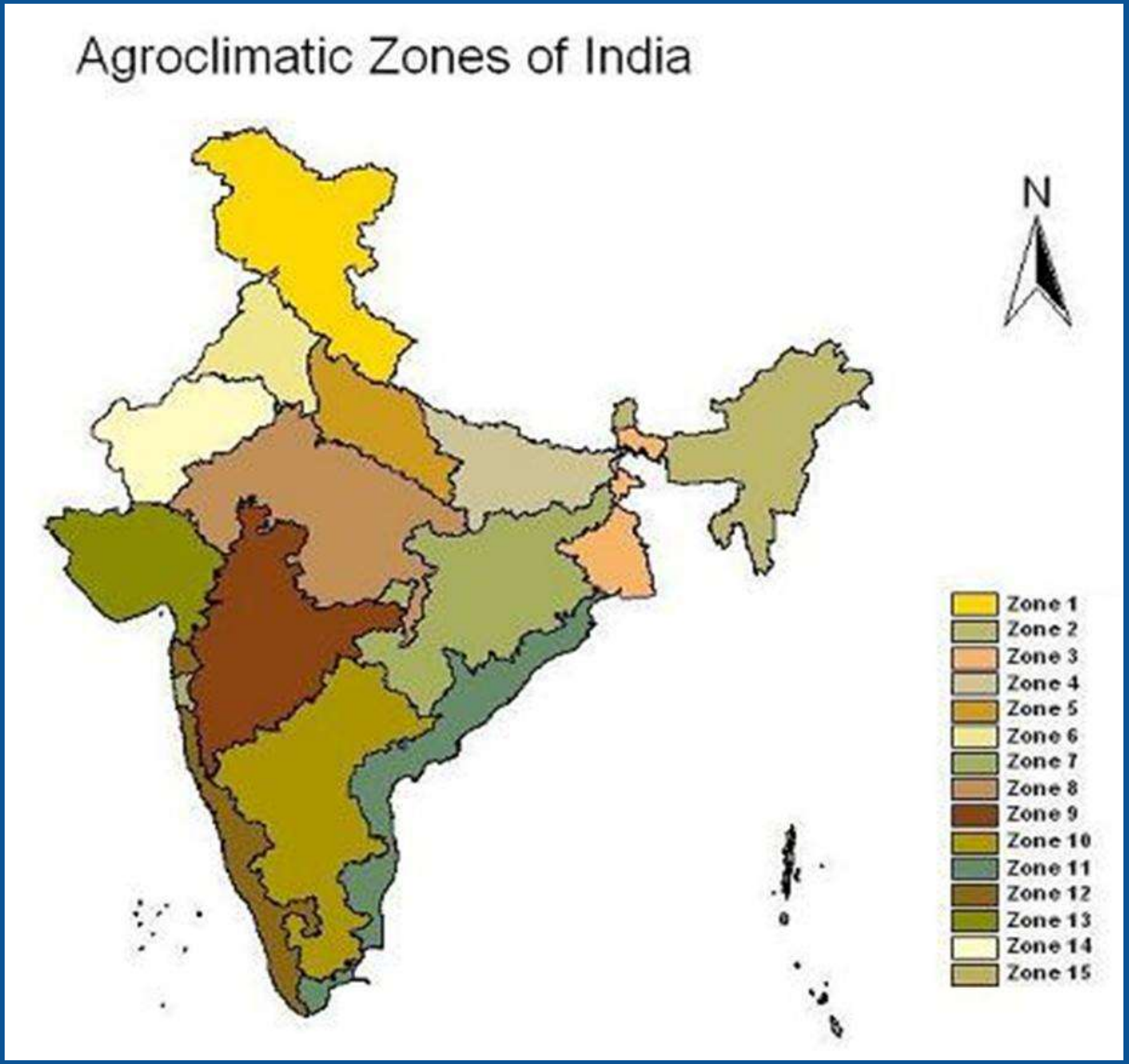
Farmers (10 from each Village for Enquiry and 2 for Observation method)

Wholesalers, Retailers, Godowns/Cold stores and Processing units (2 each per District)

Selection of Agro-Climatic Zones

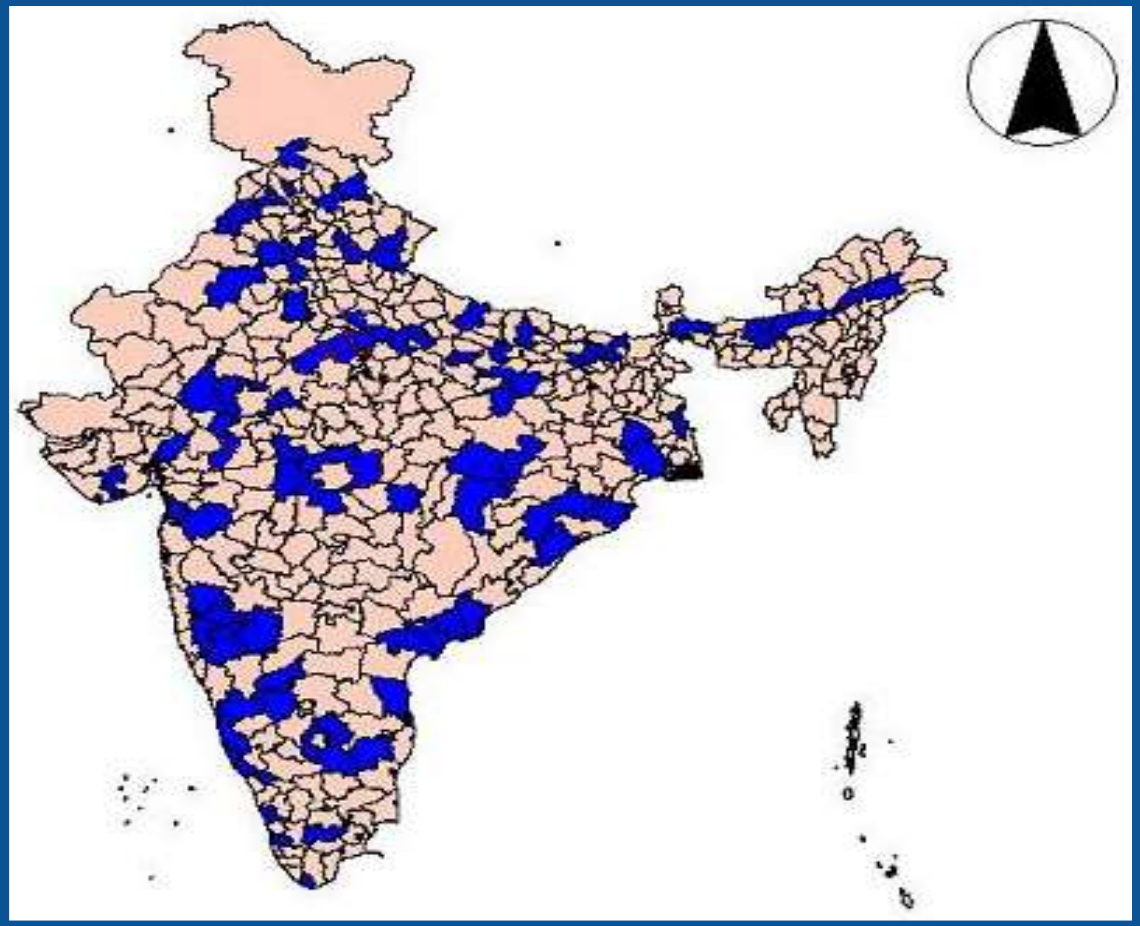
14 agro climatic zones of the country were taken, in 2012-2014 study, and

15 agro-climatic zones in 2021-22 study



Districts' Selection

The survey was conducted by 36 Centres of ICAR-AICRP on PHET in 120 and 292 districts by NABCON in previous two studies and 2022 respectively.



Location of selected districts for data collection in 2012-14

Schedules Developed for Sample Survey

Complete Enumeration (2)

Schedule 1: Complete enumeration of households of the selected village

Schedule 3: Complete enumeration of wholesaler/ retailer/ warehouse/processing unit in the selected district

Detailed Survey by Enquiry (3)

Schedule 2 A: Losses at producer level (Farm operations)

Schedule 2 B: Losses at producer level (Storage)

Schedule 4: Losses at market level (Wholesaler/ retailer/warehouse/processing unit)

Schedules Developed for Sample Survey

Detailed Survey by Observation (18)

Schedule 5-C:	**Losses at Farm Level in Cereals and coriander**
Schedule 5-OP:	**Losses at Farm Level in Oilseeds & Pulses**
Schedule 5-Pepper:	**Losses at farm level in pepper**
Schedule 5-H:	**Losses at farm level in Fruits and plantation crops**
Schedule 5-S:	**Losses at Farm Level in Sugarcane**
Schedule 5-V:	**Losses at Farm Level in Vegetable Crops**
Schedule 5-E:	**Losses of Egg at producer level**
Schedule 5-FM:	**Losses at Farm/ Fisherman level in Marine Fish**
Schedule 5-IF:	**Losses at Farm/ Fisherman level in Inland Fish**
Schedule 5-Meat:	**Losses of Meat (slaughter and post-slaughter) at producer level**
Schedule 5-PM:	**Losses of Poultry meat (slaughter & post-slaughter) at producer level**
Schedule 5-Milk:	**Post-harvest Losses in milk**

Schedules Developed for Sample Survey

Detailed Survey by Observation during storage

Schedule 6-C: Losses during storage at Farm/Trader/Godown/ Processing unit Level for cereals, pulses, oilseeds & coriander

Schedule 6-H: Losses during Storage at Farmer/Trader/Retailer/ Processing unit/Godown level in fruits, vegetables & plantation crops

Schedule 6-E: Losses of eggs during transportation and storage at farm/ wholesaler/ retailer level

Schedule 6-MF: Losses at market level storage, drying & transportation for Wholesale/retail/ pre-processing/ processing unit in Marine Fish

Schedule 6-IF: Losses at market level storage & transportation for Whole-sale/retail/ pre-processing/ processing unit in Inland Fish

Total No. of Schedules Developed/refined were 23

Fields and Plots' Selection

- Random sampling technique
- For field crops, a plot of 5×5 m (for plains), or 2×10m (for hilly regions), to assess the losses by actual observation.
- For fruits, a cluster of 4 fruit bearing trees were selected for observation.
- In case of fish, two fish ponds in a village
- Two egg and poultry units in a village/ block
- Training to Field Investigators for collection of data and filling the Survey Schedules
- No intervention in farmers' practices.

Data Collection

- **Duration of Survey/ Data Collection**: One crop cycle, limited to one agricultural year.
- Data were collected as per 23 survey schedules developed
- Data during farm operations were collected for each harvest in a year
- Periodicity of data collection during storage is once per month for one year for durables and once/twice in a week for perishables.

Data Entry and Scrutiny

- Data were digitized using **Data Entry Software developed**
- Data were thoroughly scrutinized and randomly checked/validated from the field register.
- Scrutiny of data was carried out on following criteria
    - Productivity
    - Repetition in data
    - Cross checking
    - Trend and ambiguity, etc.

Data Entry and Scrutiny

- Missing records were completed from original records or in some cases collected in next crop cycle
- Data were transformed to specific format for SAS analysis
- Sample Weights for each selection stage (Block and Village) were calculated and included in the analysis tables

Data Analysis

- Enquiry and observation data were analyzed separately at district level
- Pooling of enquiry and observation data at district level was done through inverse weighting of Variance
- Agro-climatic Zone level estimates were obtained by pooling losses weighted by production of crop of selected districts
- Production data of each agro-climatic zone were compiled
- Enquiry and observation data were merged
- Losses were estimated at national level weighted by Zone production
- In third study state-wise losses were also calculated

Data Analysis

- Data collected through enquiry method were analyzed by appropriate technique using Statistical Analysis Software (SAS)

- Results of data analyzed for each selected district were pooled at higher levels (i.e. agro-climatic zones/ national) by assigning appropriate weights based on the production of the specific crop/commodity to get the estimated loss of produce.

Sample Distribution in second study

S. No.	Crop Name	Districts Surveyed	Zones covered
1	Paddy	51	9
2	Wheat	38	10
3	Maize	22	5
4	Bajra	25	8
5	Sorghum	12	4
6	Pigeon Pea	23	7
7	Chick Pea	23	7
8	Greengram	38	9
9	Black Gram	39	8
10	Mustard	24	9
11	Groundnut	35	8
12	Soybean	20	4
13	Safflower	5	2
14	Sunflower	7	2
15	Cottonseed	15	6
16	Apple	7	1
17	Banana	27	6
18	Citrus	20	6
19	Grapes	10	4
20	Guava	20	6
21	Mango	30	9
22	Papaya	19	6
23	Sapota	9	3

Sample Distribution

S. No.	Crop Name	Districts Surveyed	Zones covered
24	Cabbage	31	9
25	Cauliflower	34	8
26	Green Pea	26	5
27	Mushroom	7	4
28	Onion	27	6
29	Potato	32	9
30	Tomato	32	7
31	Tapioca	13	4
32	Arecanut	15	4
33	Black Pepper	5	1
34	Cashew	11	4
35	Chilli	21	5
36	Coconut	23	4
37	Coriander	6	4
38	Sugarcane	27	7
39	Turmeric	8	4
40	Egg	22	6
41	Inland Fish	23	7
42	Marine Fish	15	4
43	Meat	14	5
44	Poultry Meat	21	6
45	Milk	12	5

RESULTS

Percent Losses during farm operations in Cereals 2014 study

S. No	Crop	Operations							Total Loss in Farm operations
		Harvest	Collection	Threshing	Winnowing/ Cleaning	Drying	Packag -ing	Tran sport	
1	Paddy	2.08	0.37	1.44	0.50	0.10	0.08	0.09	**4.67**
2	Wheat	1.43	0.56	1.43	0.40	0.07	0.10	0.08	**4.07**
3	Maize	1.42	0.42	1.20	0.40	0.18	0.16	0.13	**3.90**
4	Bajra	1.15	0.43	2.15	0.19	0.16	0.20	0.15	**4.43**
5	Sorghum	1.47	0.33	2.04	0.47	0.08	0.28	0.09	**4.78**

Percent Losses during Storage in Cereals 2014 study

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole-saler	Retailer	Process-ing unit		
1	Paddy	**4.67**	0.39	0.07	0.21	0.02	0.16	**0.86**	**5.53** **(5.19)** **(4.77)**
2	Wheat	**4.07**	0.53	0.03	0.10	0.02	0.17	**0.86**	**4.93** **(5.96)** **(4.17)**
3	Maize	**3.90**	0.21	0.04	0.30	0.12	0.08	**0.75**	**4.65** **(4.10)** **(3.88)**
4	Bajra	**4.43**	0.38	0.02	0.21	0.12	0.06	**0.79**	**5.23** **(4.80)** **(4.37)**
5	Sorghum	**4.78**	0.24	0.08	0.73	0.15	0.02	**1.21**	**5.99** **(3.87)** **(5.92)**

Figures in parentheses - overall total loss during 2005-06 & 2021-22

Percent Losses during farm operations in Pulses 2014 study

S. No.	Crop	Operations							Total Loss in Farm operations
		Harvest	Collection	Thresh-ing	Winnow-ing/ Cleaning	Drying	Packag-ing	Transp ort	
6	Pigeon Pea	1.18	0.39	2.13	0.41	0.18	0.22	0.19	**4.69**
7	Chick Pea	1.87	1.19	2.60	0.58	0.40	0.25	0.35	**7.23**
8	Black Gram	1.82	1.01	1.94	0.48	0.26	0.23	0.15	**5.89**
9	Green Gram	2.00	0.76	1.54	0.36	0.33	0.22	0.14	**5.37**

Percent Losses during Storage in Pulses 2014 study

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole -saler	Retailer	Process- ing unit		
6	Pigeon Pea	**4.69**	1.02	0.10	0.08	0.16	0.32	**1.67**	**6.36 (5.39) (5.65)**
7	Chick Pea	**7.23**	0.41	0.04	0.34	0.17	0.21	**1.18**	**8.41 (4.28) (6.74)**
8	Black Gram	**5.89**	0.62	0.04	0.20	0.19	0.13	**1.18**	**7.07 (6.06) (5.83)**
9	Green Gram	**5.37**	0.41	0.00	0.39	0.31	0.13	**1.24**	**6.60 (5.51) (6.19)**

Figures in parentheses - overall total loss during 2005-06 & 2021-22

Percent Losses during farm operations in Oilseeds 2014 study

S. No.	Crop	Operations							Total Loss in Farm operations
		Harvest	Collection	Thresh-ing	Winnow-ing/ Cleaning	Drying	Packag-ing	Transp ort	
10	Mustard	1.85	0.54	1.78	0.64	0.19	0.18	0.14	**5.32**
11	Cotton seed	2.01	0.32			0.02	0.05	0.14	**2.54**
12	Soybean	5.45	1.17	1.45	0.52	0.07	0.16	0.14	**8.95**
13	Safflower	1.08	0.49	0.49	0.25	0.11	0.20	0.17	**2.80**
14	Sunflower	0.96	0.40	1.76	0.25	0.11	0.10	0.07	**3.65**
15	Groundnut	2.05	0.52	1.64	0.43	0.13	0.19	0.12	**5.09**

Percent Losses during Storage in Oilseeds 2014 study

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole-saler	Retailer	Process-ing unit		
10	Mustard	5.32	0.11	0.02	0.06	0.03	0.01	0.22	5.54 (8.89) (4.46)
11	Cottonseed	2.54	0.04	0.01	0.47	0.02	0.00	0.54	3.08 (2.76) (2.87)
12	Soybean	8.95	0.12	0.14	0.34	0.15	0.25	1.00	9.96 (6.26) (7.51)
13	Safflower	2.80	0.01	0.02	0.30	0.11	0.00	0.44	3.24 (3.68) (3.06)
14	Sunflower	3.65	0.04	0.02	0.16	0.05	1.34	1.61	5.26 (4.55) (4.38)
15	Groundnut	5.09	0.09	0.06	0.44	0.06	0.30	0.95	6.03 (10.07) (5.73)

Figures in parentheses overall total loss during 2005-06 & 2021-22

Percent Losses during farm operations in Fruits 2014 study

S. No.	Crop	Operations					Total Loss in Farm operations
		Harvest	Collection	Sorting / grading	Packaging	Transport	
16	Apple	4.33	0.29	3.94	0.11	0.42	**9.08**
17	Banana	1.62	0.26	2.06	0.19	1.91	**6.04**
18	Citrus	1.68	0.33	3.71	0.18	1.65	**7.55**
19	Grapes	1.77	0.30	3.36	0.10	0.98	**6.52**
20	Guava	5.33	0.31	4.95	0.09	1.21	**11.90**
21	Mango	2.09	0.30	3.26	0.23	1.04	**6.92**
22	Papaya	0.98	0.42	1.46	0.34	0.92	**4.12**
23	Sapota	2.53	0.35	2.55	0.28	1.70	**7.41**

Percent Losses during Storage in Fruits 2014 study

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole-saler	Retailer	Process-ing unit		
16	Apple	9.08	0.02	0.13	0.57	0.34	0.25	1.31	10.39 (12.26) (9.51)
17	Banana	6.04	0.03	0.08	1.16	0.45	0.00	1.72	7.76 (6.60) (7.57)
18	Citrus	7.55	0.04	0.02	0.91	1.12	0.06	2.14	9.69 (6.38) (7.71)
19	Grapes	6.52	0.01	0.00	0.78	1.24	0.09	2.11	8.63 (8.30) (7.15)
20	Guava	11.90	0.23	0.00	1.62	2.08	0.04	3.98	15.88 (18.05) (15.05)
21	Mango	6.92	0.11	0.01	0.69	1.18	0.25	2.24	9.16 (12.74) (8.53)
22	Papaya	4.12	0.05	0.01	0.79	1.71	0.03	2.58	6.70 (7.36) (6.59)
23	Sapota	7.41	0.01	0.25	0.89	1.13	0.03	2.31	9.73 (5.77) (9.53)

Figures in parentheses - overall total loss during 2005-06 & 2021-22

Percent Losses during farm operations in Vegetables 2014 study

S. No.	Crop	Operations					Total Loss in Farm operations
		Harvest	Collection	Sorting / grading	Packaging	Transport	
24	Cabbage	1.74	0.38	3.32	0.36	1.02	**6.81**
25	Cauliflower	2.21	0.26	3.78	0.38	0.92	**7.55**
26	Green Pea	2.25	0.32	2.41	0.13	0.61	**5.72**
27	Mushroom	0.99	0.04	5.34	0.18	0.77	**7.32**
28	Onion	2.62	0.44	2.35	0.12	0.51	**6.05**
29	Potato	2.58	0.25	2.93	0.06	0.72	**6.54**
30	Tomato	3.16	0.52	3.74	0.24	1.75	**9.41**
31	Tapioca	1.23	0.30	0.99	0.09	0.61	**3.22**

Percent Losses during Storage in Vegetables

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole-saler	Retailer	Process-ing unit		
24	Cabbage	6.81	0.16	0.08	0.89	1.42	0.02	2.56	9.37 (6.94) (8.15)
25	Cauliflower	7.55	0.09	0.07	0.83	1.00	0.00	2.00	9.56 (6.88) (7.89)
26	Green Pea	5.72	0.05	0.00	1.09	0.55	0.03	1.73	7.45 (10.28) (6.43)
27	Mushroom	7.32	0.66	0.00	0.00	1.52	0.00	2.19	9.51 (12.54) (7.2)
28	Onion	6.05	0.35	0.30	0.77	0.72	0.01	2.16	8.20 (7.51) (7.26)
29	Potato	6.54	0.15	0.17	0.34	0.11	0.02	0.78	7.32 (8.99) (5.96)
30	Tomato	9.41	0.12	0.00	1.26	1.63	0.02	3.03	12.44 (12.98) (11.61)
31	Tapioca	3.22	0.28	0.00	0.31	0.59	0.17	1.36	4.58 (9.19) (4.87)

Figures in parentheses - overall total loss during 2005-06 & 2021-22

Percent Losses during farm operations in Plantation Crops/Spices 2014 study

S. No.	Crop	Operations								Total Loss in Farm operations
		Harvest	Collection	Sorting / Grading	Thresh-ing	Winnowing / Cleaning	Dry-ing	Packag-ing	Transport	
32	Arecanut	1.24	0.39		0.71	1.19	0.19	0.05	0.17	**3.94**
33	Black Pepper	0.47	0.21		0.23	0.02	0.04	0.01	0.00	**0.99**
34	Cashew	1.45	0.57		1.34	0.30	0.07	0.00	0.07	**3.82**
35	Chilli	1.60	0.84	2.18			0.02	0.15	0.30	**5.11**
36	Coconut	1.37	0.20		1.02	0.37	0.36	0.08	0.05	**3.45**
37	Coriander	2.48	0.92		1.07	0.45	0.01	0.09	0.31	**5.33**
38	Sugarcane*	2.11	0.04	1.02			3.95	0.07	0.10	**7.29**
39	Turmeric	2.41	0.10	0.79			0.16	0.09	0.04	**3.60**

**** Loss during drying of sugarcane pertains to Staling loss***

Percent Losses during Storage in Plantation Crops & Spices 2014 study

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole-saler	Retailer	Process-ing unit		
32	Arecanut	3.94	0.02	0.00	0.48	0.10	0.36	0.97	4.91 (7.87) (4.41)
33	Black Pepper	0.99	0.01	0.00	0.00	0.18	0.00	0.20	1.18 (3.86) (1.29)
34	Cashew	3.82	0.00	0.00	0.14	0.03	0.17	0.35	4.17 (1.12) (3.72)
35	Chilli	5.11	0.03	0.00	0.99	0.31	0.06	1.40	6.51 (5.60) (6.11)
36	Coconut	3.45	0.08	0.00	0.61	0.25	0.38	1.32	4.77 (5.36) (3.86)
37	Coriander	5.33	0.03	0.00	0.27	0.26	0.00	0.55	5.87 (7.31) (5.32)
38	Sugarcane	7.29	0.04	0.00	0.42	0.11	0.04	0.60	7.89 (8.64) (7.33)
39	Turmeric	3.60	0.09	0.00	0.62	0.06	0.06	0.84	4.44 (7.37) (5.36)

Figures in parentheses overall total loss during 2005-06 & 2021-22

Percent Loss during operations in Livestock Produce 2014 study

S. No.	Crop	Operations						Total Loss in Farm operations
		Harvest / Catch	Collection	Sorting / grading	Drying	Packaging	Transport	
40	Egg		1.92	1.40		1.21	0.36	**4.88**
41	Inland Fish	1.74	0.37	1.72		0.18	0.17	**4.18**
42	Marine Fish*	7.40	0.75	0.41	0.13	0.00	0.91	**9.61**
43	Meat	1.78		0.21			0.00	**1.99**
44	Poultry Meat	1.62		0.46		0.00	0.66	**2.74**
45	Milk	0.21	0.18			0.30	0.02	**0.71**

**** Data of Harvesting operation is based on enquiry only***

Percent Loss during Storage in Livestock Produce 2014 study

S. No.	Crop	Total Loss in Farm operations	Storage Channels					Total Loss in Storage	OVERALL TOTAL LOSS
			Farm	Godown	Whole-saler	Retailer	Process-ing unit		
40	Egg	4.88	0.07	0.00	1.35	0.89	0.00	2.31	7.19 (6.55) (6.03)
41	Inland Fish	4.18	0.09	0.00	0.24	0.72	0.00	1.05	5.23 (6.92) (4.86)
42	Marine Fish	9.61	0.00	0.00	0.65	0.26	0.00	0.91	10.52 (2.78) (8.76)
43	Meat	1.99	0.00	0.01	0.46	0.25	0.00	0.72	2.71 (2.23) (2.34)
44	Poultry Meat	2.74	0.00	0.00	3.02	0.97	0.00	4.00	6.74 (3.65) (5.63)
45	Milk	0.71	0.00	0.00	0.00	0.00	0.21	0.21	0.92 (0.77) (0.87)

Figures in parentheses overall total loss during 2005-06 & 2021-22

Highest losses during storage **2014 study**

	Loss, %		
	Farm storage	**Wholesaler**	**Retail**
Cabbage	7.2	8.4	
Guava			13
Mango	11.5		11.3
Onion	6.8	12.7	12.7
Tomato	8.7	9.6	**18.2**
Groundnut	12.3	6.7	15
Pigeon pea	10		
Paddy	5.9		
Wheat	8.9		

Comparison of Losses of 2012-13 with study in 2005-07 & 2021-22

S.No.	Commodity	2005-07	2012-13	2021-22
1	PADDY	5.2	5.5	4.77
2	WHEAT	6	4.9	4.17
3	MAIZE	4.1	4.6	3.88
4	BAJRA	4.8	5.2	4.37
5	SORGHUM	3.9	6.0	5.92
6	PIGEON PEA	5.4	6.4	5.65
7	CHICK PEA	4.3	8.4	6.74
8	BLACK GRAM	6.1	7.1	5.83
9	GREEN GRAM	5.5	6.6	6.19
10	MUSTARD	8.9	5.5	4.46
11	COTTONSEED	2.8	3.1	2.87
12	SOYBEAN	6.2	10.0	7.51
13	SAFFLOWER	3.7	3.2	3.06
14	SUNFLOWER	4.5	5.3	4.38
15	GROUNDNUT	10.1	6.0	5.73
16	APPLE	12.3	10.4	9.51
17	BANANA	6.6	7.8	7.57
18	CITRUS	6.3	9.7	7.71
19	GRAPES	8.3	8.6	7.15
20	GUAVA	18	15.9	15.05
21	MANGO	12.7	9.2	8.53
22	PAPAYA	7.4	6.7	6.59
23	SAPOTA	5.8	9.7	9.53

Comparisons of PH Losses

S. No.	Commodity	2005-07	2012-13	2021-22
24	CABBAGE	6.9	9.4	8.15
25	CAULIFLOWER	6.8	9.6	7.89
26	GREEN PEA	10.3	7.4	6.43
27	MUSHROOM	12.5	9.5	7.2
28	ONION	7.5	8.2	7.26
29	POTATO	9	7.3	5.96
30	TOMATO	12.4	12.4	11.61
31	TAPIOCA	9.8	4.6	4.87
32	ARECANUT	7.9	4.9	4.41
33	BLACK PEPPER	3.9	1.2	1.29
34	CASHEW	1.1	4.2	3.72
35	CHILLI	5.6	6.5	6.11
36	COCONUT	5.4	4.8	3.86
37	CORIANDER	7.3	5.9	5.32
38	SUGARCANE	8.7	7.9	7.33
39	TURMERIC	7.4	4.4	5.36
40	EGG	6.6	7.2	6.03
41	INLAND FISH	6.9	5.2	4.86
42	MARINE FISH	2.8	10.5	8.76
43	MEAT	2.3	2.7	2.34
44	POULTRY MEAT	3.7	6.7	5.63
45	MILK	0.8	0.9	0.87

Possible reasons for increase in losses during 2012-13 in comparison to 2005-07

- Natural calamities (Cyclones *Phalin* in Odisha, *Helen and Lehar* in AP) occurred during the period of study resulting higher losses of cereals, pulses, oilseeds and plantation crops in coastal and adjacent states of India during 2012-14.
- Threshing of pulses using high capacity threshers in Maharashtra in 2012-14.
- Inclusion of harvest operation in marine fish data in 2012-14 study (not covered in previous study).
- Sharp fall in prices of cauliflower and cabbage in 2013-14 and therefore farmers left their produce in field during February.

Possible reasons for decrease in losses particularly in apple, guava, mango

- Increase in infrastructural facilities (cold stores, CAP system in Srinagar, better Roads) and marketing yards.
- Increased Awareness among stakeholders during 2021-22
- Better harvesting & processing machinery
- Increased awareness about post-harvest losses.
- Increased level in processing of perishables

Monitory Values of Losses

For computation of monitory values of losses, average wholesale prices of 2014 and production data of 2012-13 were considered

	Crops/commodity	Sectoral Total Loss (Rs. in Crores)
1.	Cereals	20698
2.	Pulses	3877
3.	Oilseeds	8278
4.	Fruits	16644
5.	Vegetables	14842
6.	Plantation crops & spices	9325
7.	Livestock produce	18987
Grand Total		**92651**

Total monitory loss, 2005-06 study: Rs. 44143 crore (2008-09 prices)

At 2011-12 prices Rs 74734.37 crore, First study 63103.53 crore

About 18.43 % higher monitory loss is due to substantial increase in production

- Quantity of Post-harvest losses of foods decreased from about 74.11 million tonne in 2012 to 66.48 million tones in 2021 (accounting for 54 commodities). Saving of 7.63 millions of foods.

- PH loss study of 2012-13 reported monetary loss of **₹92,651 crore About 11300 million USD) (for 65.4 million tonnes of 45 commodities only**). With the premise that if the extent of losses recorded in 2012-13 would have continued, the value loss estimated would have been **₹1,66,593.72 crore** (about 2030 million USD) in 2021-22.

- However, current study by NABCON (2021-22) estimated the monetary loss of **₹1,46,153.15** crore (about 17820 million USD) for 45 crops covered under 2012-13 study. The difference of monetary losses of 45 commodities resulted in savings of **₹20,440.58 crore (about 2493 USD)**.
- ICAR recommendations for uniform norms for loss calculation in FCI and CWC godowns (One nation one norms) and adoption by them, it saves around Rs. 540 crore (about 660 million USD) annually to FCI.

Conclusions

1. The methodologies developed in 2005-6 study and improved & corrected in 2012-13 study, and successfully used by the third party NABCON for Nation-wide study of post-harvest losses for 54 commodities.

2. The developed methodology at national level is robust and time tested. As per information through IASRI FAO, UN has also accepted this methodology for post-harvest loss estimation and endorsed to follow by other nations as well.

3. Post-harvest overall losses in India is decreasing (from 4.6 – 15.9 % to 3.88 – 15.05 %), but still it is huge.

4. The quantity of post-harvest losses of foods decreased from around 74.11 million tons in 2012 to 66.48 million tons in 2021. **The saving of 7.63 million tons of foods was possible due to research and technology interventions and better infrastructure for** transport, storage and processing of agricultural commodities

Recommendations

1. Sensitizing farmers for use of scientific tools, machines for harvesting, threshing, handling, storage and transport **(Skill development)**
2. Construction of CIPHET-evaporatively cooled structure for short term storage of fruits and vegetables in hot and dry region may be made compulsory **(on-farm development).**
3. Multi-commodity cold storage in rural areas and mandies, cold chain, roads, are essential (**infra development).**
4. Long distance transport of perishables needs further attention–Horti/Kisan train using air cooled containers of NHB-CIPHET may be used and dedicated freight corridor for them should be developed (**service sector development**)
5. Further refinement in harvesting & threshing machines are advised to reduce losses (**technological development**).

Recommendations

6. **Huge no of technologies have been developed for post-harvest management and value addition. Each district therefore should establish Crop Processing Training-cum-Incubation centre in production catchment (entrepreneurship development).**

7. **Post-harvest policy of the country should be developed and implemented.**

8. **On the 29th September world should come together and observe the International day of Awareness on Food Loss and Waste Reduction (already FAO, UN is observing) and take pledge as done today.**

Thank You