

Creating Awareness and Capacity Building Among Farmers: Effective Way of Crop Residue Management



ICAR-Agricultural Technology Application Research Institute, Zone-II

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1. Introduction

Rice-wheat cropping system playing a significant role in existing cropping systems. In indo-gangetic plains of country this cropping system provides more than 25% food production in India out of total food production. Rice, wheat and rice-wheat cropping system are grown in an area of 44, 28 & 10.5 million ha land of our country, respectively. In Haryana, 58 per cent of cultivated area is under rice-wheat cropping system. The total paddy area is around 1.21 Mha in the state, crop residue burning (stalks and stubble) during rice harvesting periods in the Haryana is one among the many sources of air, land and water pollution. Consequently, it has adverse consequences on the quality of soil. It also adversely affects the nutrient budget in the soil. When the crop residue is burnt, existing minerals present in the soil get destroyed which adversely hampers the cultivation of the next crop. In the field, impact of burning includes removal of a large portion of the organic material, while nitrogen, phosphorus, potassium and sulphur are completely burnt. The off field impacts are related to human health due to general air quality degradation resulting in aggravation of respiratory (like Cough, Asthma, Bronchitis), eye and skin diseases. Burning of crop residue also contributes indirectly to the increased ozone pollution. The black soot generated during burning also results in poor visibility. It could lead to increased road side incidences of accident. Heat generated from the burning of crop residues elevates soil temperature causing death of active beneficial microbial population, though effect is temporary, as the microbe's regenerate after a few days. Repeated burnings in a field, however, diminishes the microbial population permanently. One ton of rice straw on burning releases about 3 kg particulate matter, 60 kg CO, 1460 kg CO₂, 199 kg ash and 2 kg SO₂ (Gadi, 2003). Besides other light hydrocarbons, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), SO₂ and NO₂ are also emitted.

1.1 Reasons behind on-farm burning of crop residues

Farmers and policy makers are well-aware of the adverse consequences of on-farm burning of crop residues. However, because of increased mechanization, particularly the use of combine harvesters, major reasons for rapid increase in the use of combines are labour shortage, high wages during harvesting season, ease of harvesting and thrashing and uncertainty of weather. On using combine harvesting, about 80% of the residues are left in the field as loose straw that finally ends up being burnt on farm. There are some other reasons also behind intentional burning of crop residues. These includes declining numbers of livestock, long period required for composting, and in some areas soil has high clay content. This type of soil is prone to drainage and compaction problem which can make burning more attractive option than tillage. Some other important reasons are briefly described below:

To control rats: Farmers believe that rice straw serves as hiding and breeding place for rats. Field rat is most damaging vertebrate in rice fields.

Yellowing of seedling: Partially decomposed straw lead to yellowing of newly transplanted seedling. Farmers do not realize that its merely temporary.

Lack of man power: Spreading rice straw is perceived to be laborious. There is shortage of man power to deal leftover residue of straw. Farmers burn it to save money as well as time.

Timely sowing of next crop: After harvesting of rice, there is very less time for land preparation for the sowing of wheat. Hence, farmers burn residue for timely sowing of next crop.

To kill insect pest and disease pathogen: it is believing that after heating operation, most of larva of insect pest and disease are died. Their attack to next crop will be less due to killing of most of the top larvae of pathogen by heating of top surface. The unavailability of alternative economically viable solutions, farmers are compelled to burn the residues.

It is a paradox that burning of crop residues and scarcity of fodder coexists in this country, leading to significant increase in prices of fodder in recent years. Industrial demand for crop residues is also increasing. To manage the residues in a productive and profitable manner, conservation agriculture (CA) offers a good promise. With the adoption of CA-based technologies these residues can be used for improving soil health, increasing crop productivity, reducing pollution & enhancing sustainability and resilience of agriculture. The gravity of the situation demands that an appropriate policy should be evolved to promote multiple uses of crop residues in the context of CA and to prevent their on-farm burning. So that central government, its various ICAR research institutes and other institutions like Haryana Agricultural University, Hisar and Punjab Agricultural University, Ludhiana are all making efforts to devise some alternate economic uses of rice stubble. These include the stubble treated with urea as a fodder for animals, mushroom cultivation, its use in bio-thermal energy production, paper manufacturing, bedding for animals, etc. Central government is also providing subsidy to the farmers to promote the use of equipment's which help in checking the burning of crop residues, like happy seeder, zero-till-drill, paddy straw mulcher, shrub master/cutter cum spreader, reversible MB plough and rotavator. So that with the help of these implement, farmers can directly sow wheat crop after harvesting of rice or they can incorporate crop residue in the same field before sowing of next crop. To address this menace, Govt. of India has initiated Central Sponsored Scheme entitled, "Promotion on Agricultural Mechanization for In-situ Management of Crop Residue in the State of Punjab, Haryana, Uttar Pradesh and NCT of Delhi" with an outlay of 1152 crores for this scheme. Information, Education and Communication (IEC) is the important component of this scheme and state agricultural departments/Krishi Vigyan Kendras (KVKs), ICAR institutes and State Agricultural Universities (SAUs) are the important partners in this endeavour. One of the important components of the project is capacity building and making awareness among all stakeholders for the in-situ crop residue management (CRM).

Under this scenario, the main focus in the bulletin has been with aims at reduce environmental pollution and improve soil health by in-situ crop residue management through capacity building/trainings to Subject Matter Specialists of different KVKs and farmers. The other ways are to develop related literature & distribution, organisation of state level workshop, kisan mela and demonstrations for safe and sustainable management of crop residues for productive, profitable and sustainable agriculture.

2. Performance of Agriculture Mechanization KVK wise perform and performance of different programme & activities carried out is narrated here in.

2.1 KVK, Ambala

To vacate fields for the timely sowing of wheat, majority of the rice straw is burnt in situ by the farmers because residues interfere with tillage and seeding operations for the next crop. The burning of one ton of paddy straw results into loss of approximately 5.5 kg N, 2.3 kg P₂O₅, 25 kg K₂O, 1.2 kg S, 50-70% of micronutrients absorbed by rice and 400 kg of carbon (Anonymous, 2013b).

KVK, Ambala organized various training programmes on crop residue management in which different issues and challenges are dealt with such as sowing wheat with happy seeder and benefits of wheat sown by happy seeder. Initially, one-day training programme was conducted in adopted village Landha on 10th July 2018.

Then five-day training programmes on CRM were conducted in KVK campus in which 27 farmers participated during 27-31 August, 2018 (Table 2.1.1). Farmers from adopted village sapeda were participated in the programme and they motivated other farmers from their respective villages to participate in such training programmes. Dr. Rajbir Singh, Director, ATARI-Zone-I had also inaugurated the training programme and DD-Kisan Channel exclusively covered the programme. Farmers were appraised about machinery, implements and equipment like happy seeder, straw chopper, shrub master, super SMS for combine harvesters, zero till seed drill and reversible M.B. Plough et. and were given live demonstrations of the machineries being used for this purpose. They were also made aware about latest CRM related equipment through exposure visit at Dasmesh Mechanical Works at Amargarh (Punjab).

The second training programme was conducted at KVK Ambala for the farmers of village Landa and Khudda Kalan during 20-26 September, 2018 and demonstrations were organized for the benefit of entire village. These farmers' knowledge about efficient CRM technologies was upgraded through exposure visit at kisan mela at PAU, Ludhiana (Table 2.1.2). Farmers were encouraged to stop the

Table 2.1.1 Five-days training programmes organized by KVK on in-situ CRM

S.No.	Date	Participants	Venue
1.	27-31, August, 2018	27	KVK, Ambala
2.	20-26, September, 2018	23	KVK, Ambala



Training Programme of In-situ CRM at KVK, Ambala

Table 2.1.2 Exposure visits of farmers by KVK, Ambala

S.No.	Date	Participants	Venue
1.	29 th August, 2018	27	Dasmesh Mechanical Works, Amargarh
2.	20 th September, 2018	23	Kisan Mela at PAU, Ludhiana

practice of straw burning and also told to extend knowledge gained during trainings to the fellow farmers. In addition to this, KVK also imparted the one-day training to farmers provided by the Department of Agriculture, Ambala during 11-14 September, 2018 (Table 2.1.3). In which total 325 farmers participated from all the blocks of district, Ambala.

Table 2.1.3 One-day training programme organized by KVK, Ambala

S.No.	Date	Participants	Place	Blocks
1.	11 th September, 2018	130	KVK, Ambala	Ambala-II and Saha
2.	12 th September, 2018	130	KVK, Ambala	Barara and Ambala-I
3.	13 th September, 2018	130	KVK, Ambala	Shejadpur and Nariangarh
4.	14 th September, 2018	107	KVK, Ambala	Ambala-II and Ambala-I

Two farmers-scientists interface were also conducted for horizontal expansion of residue management technology, by which more number of farmers were aware about the benefits of no residue burning. First farmers-scientists interface was conducted at KVK campus, while the second interface was conducted at village Sapeda on dated 21th October, 2018. On this occasion, Dr. V.P. Chahal (ADG-Agricultural Extension) and district authorities were also participated and motivated the farmers through live demonstrations.



Training Programme of In-situ CRM at KVK, Ambala

2.2 KVK, Bhiwani

Under the CRM project, awareness campaigns were organized at village and block level. In these awareness programmes, the very first step taken was Participatory Rural Appraisal (PRA) to find out the key root problems and strengths of the adopted villages *i.e.*, Nimri and Malkosh. Farmers were taught about the harmful effects of paddy straw burning. Three awareness programmes were also organized in collaboration with District Development Authority (DDA).

Most of the farmers burn crop residues on their field. Due to this burning there is harmful effect on human health, animal health, and soil health. Environment is also being polluted due to paddy stubble burning. So these awareness campaigns were organized at these paddy growing areas specially. More than about 800 farmers participated in these programme.

2.2.1 Organization of Training Programme

One-day farmers' trainings were also organized in Biran, Nathuwas, Chang, Nimri, Malkosh, at Chandwas village of Bhiwani district. In these trainings', awareness was created among the farmers about harmful effects of straw burning. Soil health is depleting day-by-day. Due to burning of straw, microorganisms which make the soil fertile get killed. In these trainings, farmers were well trained on proper stubble management.

Five-days' farmer's trainings were organized in adopted villages' *i.e.*, Nimri and Malkosh. In these training courses farmers were well trained on the CRM activities, soil health, organic farming, use

of paddy straw, agricultural mechanization for CRM, B:C ratio in CRM, seed treatment in rabi crops, etc. by the experts. Fifty farmers were trained in two training courses.

2.2.2 Organization of Farmers-Scientists Interface

Farmers-Scientists Interface (FSI) were organized in these adopted villages. Various topics related to CRM, doubling of farmers' income, improvement of soil health etc. were covered by the resource persons. 150 farmers participated in FSI. Two-way interaction were done at these trainings. Farmers asked on their field problems. Resource persons of different fields animal sciences, pollution, health department delivered interactive talks.



Farmer-Scientist Interface at KVK, Bhiwani

KVK procured 10 CRM machinery viz. Zero Tillage, Happy Seeder, Paddy Straw Choppers and Spreader, Reversible MB plough etc. Farmers were given trainings on proper use and handling and maintenance of these implements.

2.2.3 Conductance of Demonstrations

Under this project, 250 acres' fields demonstrations were laid out in adopted villages *i.e.*, Nimri and Malkosh. Inputs: seeds of wheat variety WH 711 and Raj.3765, urea and zinc were demonstrated among the farmers. Critical inputs for one acre per farmer was given. CRM machineries were used in



Demonstrations at KVK, Bhiwani

these demonstrations. Sowing was done by happy seeder and Zero Tillage. Farmers were trained on production technology before demonstrations.

2.2.4 Organization of Kisan Mela

District level rabi kisan mela on CRM was also organized. More than 400 farmers of district Bhiwani and Charkhi Dadri participated in this mela. Professor K.P. Singh, Vice chancellor, CCSHAU addressed the farmers on this occasion. The effect of these capacity building programmes was such that not a single paddy growing farmer burnt paddy straw. Farmers incorporated the paddy straw in fields itself. District level Kisan mela for rabi on CRM has been organized in February 2019.



Kisan Mela at KVK, Bhiwani

2.3 KVK, Fatehabad

Effective technology transfer cannot be separated from human resource development and empowerment of farming community is corner stone of extension approach of the KVK. Thus, for the capacity building of the farmers about CRM, the KVK has organised about 13 training programmes of one-day duration and two training programmes of five days' duration to improve the knowledge and skills of the farmers for crop residue management. Hands on training on CRM machinery was also imparted. Farmers were trained on options available for paddy residue management, In-situ management of paddy straw either by incorporation in soil or by retaining it as mulch on soil and sowing of wheat by happy seeder, package of practices to be followed in crops where CRM has been adopted. The two nodal officers of the CRM project were also empowered by providing training on “Operational guidelines of machinery for paddy residue management” at PAU, Ludhiana. KVK started its campaign just after harvesting of wheat. Training programmes on CRM from time to time have been imparted in the district. The details of these trainings have been highlighted below (Table 2.3.1).

Table 2.3.1 Training programmes organised by KVK, Fatehabad

S.No.	Title	Date	Participants	Venue
1	Farmers' training on crop residue management	22 nd May 2018	70	KVK, Fatehabad
2	Promotion of Agricultural Mechanization for In-situ management of crop residue management	04 th July,2018	50	Haroli village



Training Programme at KVK, Fatehabad

2.3.1 Sponsored Trainings under CRM

The Department of Agriculture and Farmers Welfare, Haryana is also implementing the same scheme during the year 2018-19. Under the scheme, after requirement of department, KVK has organised eleven training programmes on CRM and trained 813 farmers of the district at campus (Table 2.3.2).



Demonstrations at KVK, Fatehabad

Table 2.3.2 Sponsored trainings under CRM

S.No.	Title	Date	Participants
1.	In-situ paddy residue management through Mechanization.	07 th September, 2018	75
2.	In-situ paddy residue management through Mechanization.	10 th September, 2018	75
3.	In-situ paddy residue management through Machinery	11 th September, 2018	75
4.	In-situ paddy residue Management through Mechanization.	12 th September, 2018	75
5.	In-situ paddy residue management through Mechanization.	13 th September, 2018	94
6.	In-situ paddy residue management through Mechanization.	14 th September, 2018	71
7.	In-situ paddy residue management through Mechanization.	15 th September 2018	87
8.	In-situ paddy residue management through Mechanization.	19 th September, 2018	68
9.	In-situ paddy residue management through Mechanization.	22 th September, 2018	72
10.	In-situ paddy residue management through Mechanization.	26 th September 2018	78
11.	In-situ paddy residue management through Mechanization.	27 th September, 2018	43
		Total	813

2.3.2 Five-days Training Programme on CRM

Under the project, two training programmes of five days' duration on CRM from 16th to 20th October, 2018 were organised at KVK campus. Fifty selected farmers of adopted villages of Haroli & Dangra have been trained on crop residue management through machinery, options for paddy residue management, hands on training about CRM machinery. These farmers acted as messenger under CRM and motivated other farmers for paddy residue management.



Training programmes on CRM at KVK, Fatehabad

2.4 KVK, Jhajjar

KVK is a district level institution designed and devoted to impart need based and skill-oriented vocational training to the practicing farmers, in-service extension personnel and to those who wish to establish in for self-employment vocations through learning by doing.

Two five days training courses on *In-situ* crop residue management through farm mechanization have been successfully organized at KVK, campus under centrally sponsored scheme “Promotion of Agricultural Mechanization for *In-situ* Management of Crop Residue in the states of Punjab, Haryana, Uttar Pradesh and NCT of Delhi”. To aware farmers and other stake holders about the ill-effects of residue burning support from central government for the cause have given huge boost to the movement started by the KVK and yields better results. Farmers participated and got the opportunity for hands on exercises and exposure visit at manufacturers of various machinery of crop residue management. During training, literature on *In-situ* management of paddy straw were also shared for further dissemination of technology. A total budget of Rs.29.14 lakh has been allotted for conducting training, demonstrations, Farmer Scientist Interface Meeting,

District level Kisan Mela, Printing of Publicity Material and Mobilization of Collage and School Students for creating awareness on paddy straw management.

Under this programme, two villages namely Palra and Baghpur were selected as operational village. Twenty-five farmers were selected randomly for each training from both the villages to promote mechanization *i.e.* baling/binding machines, combine harvester with reaper, mulchers, choppers, happy seeder, rotavators etc. to ensure minimum loss of crop residue while harvesting and its incorporation to improve soil fertility and management of natural research.



Kisan Mela at KVK, Jhajjar



Demonstrations at KVK, Jhajjar

2.4.1 Organization of Farmers-Scientists Interface

Farmers Scientist Interface meetings were organized in these operational villages. A total of 150 farmers participated in these interaction meeting and they were motivated against paddy straw burning and solutions of their problems was given by KVK scientist through application of proper technologies. KVK also laid out 250 FLDs at farmer's fields on Zero-Tillage sowing of wheat after harvesting the paddy by providing them seed, micronutrients and farm machinery viz. Happy seeder, Zero-Till Drill machine etc. The farmers get agreed to adopt these technologies and committed to motivate the farmers of neighboring villages.



2.5 KVK, Jind

Two villages Dhatrath and Durana have been under Crop Residue Management adopted for five days' trainings were organized in two villages. Awareness, Training, Demonstration other activities have been organized with active involvement farmers in the stubble villages.

2.5.1 Capacity Building Training of KVK Personals

The scientists from KVK, Jind attended following programmes in this regard conducted by ATARI/SAU (Table 2.5.1).



Table 2.5.1 Training attended by KVK scientists

S.No.	Title	Date	Venue
1	Dr. Y.P. Malik attended workshop on in-situ crop residue management	17 th October, 2018	ATARI, Ludhiana
2	Dr. RD Panwar attended workshop on in-situ crop residue management	06 th July , 2018	NASC, ICAR, New Delhi
3	Dr. Rameshwer Singh attended training on in-situ crop residue management	06 to 07 th August, 2018	ICAR, ATARI, Ludhiana
4	Dr. RD Panwar and Dr Y.P. Malik attended sensitization workshop on in-situ CRM	10 th August, 2018	CCS HAU CCS HAU Hisar

2.5.2 Capacity Building Trainings of Farmers and Extension Workers

Thereafter this centre organized trainings on CRM In-situ at village level, block and district level as a joint venture with DDA, Jind. The 20 years of RCT practices of scientists of this centre was instrumental in delivering lectures with citation of examples of farmers of that village/area at all the training camps (Table 2.5.2).

Table 2.5.2 One-day farmers training resource conservation and In-situ CRM

S.No.	Venue/ village	Date	No. of participants
1.	Hadwa	04 th September 2018	54
2.	Dhatrath	10 th September 2018	20
3.	Kharak Gadian	12 th September 2018	35
4.	Hameti	25 th September 2018	40
5.	Hameti	27 th September 2018	40
6.	Hameti	0st October, 2018	50
7.	Hameti	08 th October, 2018	45
8.	Hameti	12 th October, 2018	55
9.	Hameti	16 th October, 2018	45
10	Hameti	18 th October, 2018	50
11	Hameti	23 rd October, 2018	50



2.5.3 Literature Development

Photocopies of these various farmer's friendly literature have been developed on proper and effective in-situ crop residue management were distributed among the villagers and students for awareness as well as to develop confidence. Extension literature were provided to all the trainees from the using organization of training.



2.5.4 Participation in State Level Workshop

KVK Scientists and farmers from selected villages took part in state level workshop on In-situ crop residue management organized by ICAR-ATARI, Jodhpur in collaboration with CCS HAU, Hisar on 10th August, 2018. Farmers Scientist interaction was organized in this workshop on CRM and a healthy discussion between scientist and farmers was also held to provide appropriate answer of the queries and doubts of the farmers across the state on In-situ crop residue management.

2.5.5 Participation in Kisan Mela

KVK Jind ensured participation of the farmers from selected villages in Rabi Kisan Mela organized by CCS HAU, Hisar on the theme of In-situ crop residue management. Dr. T. Mohapatra, DG, ICAR was the chief guest of this mela. Farmers were benefitted from resource person lectures on In-situ crop residue management and demonstrations of CRM machinery. Along with this, KVK Jind also organized a Kisan Mela on In-situ crop residue management at village Pandu Pindara on 28th December, 2018. In this Kisan Mela, 400 farmers from selected as well as nearby villages participated and got knowledge about In-situ crop residue management under Rice-Wheat cropping system.



2.5.6 Conductance of Demonstrations

Demonstrations on wheat sowing by Zero-Tillage Drill, Happy Seeder and Rotavator were conducted in Durana, Dathrath, Pandu Pindara, Sangatpura, Ikas, Pathri, Makhand etc. out of these two hundred demonstration plots were conducted in Durana and Dathrath. The programme of wheat crop in residue management field in quite satisfactory.



Demonstrations at KVK, Jind

2.6 KVK, Hisar

In-situ crop residue management through agricultural mechanization is a technical as well as novel approach for the farmers of the Hisar and it require not only a healthy mind set but proper knowledge about working of different machinery for proper execution of this project.

2.6.1 Capacity Building Training of KVK Personals

To deal with all related technical issues on this approach, two scientists (Dr. Pooja Rani & Dr. Vikash Hooda) from KVK Sadalpur participated in two days training programme organized by PAU, Ludhiana and get acquainted with different methods of In-situ crop residue management and working of different CRM machinery.

2.6.2 Capacity Building Trainings of Farmers

KVK scientists initially put their efforts for building a healthy mind set of farmers towards this approach and following this, trainings were organized to take over the technical part. To technically empower the district paddy growing farmers, two five-day trainings and five one-day trainings were organized by KVK, Sadalpur. Among these two five-day trainings, one was organized at KVK premise in the collaboration of Pooja Rani, DES (Soil Science) and another was organized at selected village Ghirai, Hisar in the collaboration of Dr. Vikash Hooda (Vegetable Science). The entire fifty participants in both trainings were selected from villages Khokha & Ghirai. Different interactive lectures on types & working of CRM machinery, suitable combination of CRM machinery under different conditions, weeds & insect-pest management under in-situ crop residue management conditions, care and maintenance of CRM machinery, etc. were delivered by different experts/scientists. The resource persons from state department of agriculture were also involved to provide necessary information on schemes & subsidies on CRM machinery and on custom hiring centre establishment to the farmers. In collaboration with state department of agriculture (DDA, Hisar), five trainings were organized by KVK, Sadalpur and 440 farmers from different villages of district get benefitted from these. In all these trainings effective extension methods like power point presentations, demonstration and hands-on CRM machinery were used to effectively disseminate the information to the farmers.



2.6.3 Literature Development & Distribution

A pamphlet was prepared by KVK scientists which covers all the aspects including scenario, needs, benefits and methods of in-situ crop residue management and detail wise features of CRM machinery. Extension literature provided by ATARI, Ludhiana along with this pamphlet were provided to all the trainees from the above said trainings. Apart from this, hindi & english articles on this topic were also published in Haryana Kheti, a lead monthly agricultural magazine in Haryana.



2.6.4 Participation in State Level Workshop

KVK Scientists and farmers from selected villages took part in state level workshop on awareness of In-situ crop residue management organized by ICAR-ATARI, Jodhpur in collaboration with CCS HAU, Hisar on 10th August, 2018. Resource person lectures were organized in this workshop on CRM, a healthy discussion between resource person and farmers was organized to provide operative answer clear the queries and doubts of the farmers across the state on In-situ crop residue management.



2.6.5 Participation in Kisan Mela

KVK, Sadalpur ensured participation of the farmers from selected villages in Rabi Kisan Mela organized by CCS HAU, Hisar on the theme of In-situ crop residue management. Dr. T. Mohapatra, DG, ICAR was the chief guest of this mela. Farmers were benefitted from resource person lectures on In-situ

CRM and demonstrations of CRM machinery. Along with this, KVK, Sadalpur also organized a Kisan Mela on In-situ crop residue management at selected village Khokha on 27th December, 2018. In this Kisan Mela, 400 farmers from selected as well as nearby villages were participated and get complete knowledge about In-situ CRM under Rice-Wheat cropping system.



2.6.6 Conductance of Demonstrations

Under the central scheme of agricultural mechanization on In-situ CRM, machinery including two happy seeder, one chopper cum mulcher, one paddy shredder, two cutter cum spreader, one hydraulic reversible MB plough and three zero till drill were provided to farmers of selected villages to demonstrate suitability and efficacy of these implements on their own fields. Dr. Vikash Hooda, Dr. Pooja Rani and Dr. Satyavir Kundu provided the guidance and technical backup to 200 farmers and ensure sowing of wheat after in-situ management of paddy residues through suitable combination of machinery.



2.7 KVK, Kaithal

Two village Rasina and Hajwana have been adopted under CRM where five days' trainings were organized. After inception of CRM it was advised by ATARI to work in these two villages during inception of project it was a challenge to this KVK. KVK, Kaithal also organized awareness program with Danik Jagran on in-situ crop residue management. Publicity cum sale counter is also established in KVK, Kaithal.



2.7.1 Capacity Building Training of KVK Personals

The scientists from Kaithal, KVK attended following programmes on CRM conducted by ATARI/SAU (Table 2.7.1 & 2.7.2).

Table 2.7.1 Participation of KVK scientist in capacity building training program on in-situ CRM

S.No	Name of scientist	Venue	Date
1	Dr. R.C. Verma	ICAR-ATARI, Ludhiana	17 th Oct., 2018
2	Dr. Ajit Singh	NASC, ICAR, New Delhi	06 th July, 2018
3	Dr. Jasbir Singh	ICAR-ATARI, Ludhiana	06-07 th Aug., 2019
4	Dr Jasbir Singh attended sensitization	CCS HAU Hisar	10 th Aug., 2018
5	Dr. Devender Chahal	ICAR-ATARI, Ludhiana	21 st Jan., 2019

Table 2.7.2 Awareness programme organised

S.No.	Name of Activities	No. of participants	Place
1	Farmer-Scientist Interface	100	KVK, Kaithal
2	Group meeting	115	Malikpur, village

2.7.2 Capacity Building Trainings of Farmers and Extension Workers

Thereafter this centre organized trainings on CRM In-situ at village level, block and district level as a joint venture with DDA, Kaithal. More than 10 years of RCT practices of scientists of this centre was instrumental in delivering interactive lectures with citation of examples of farmers of that village/area at all the training camps (Table 2.7.3).

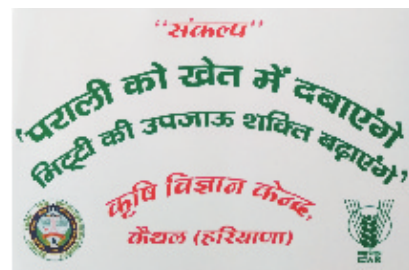
Table 2.7.3 One-day farmers' training organised in collaboration with Agriculture Department at Kaithal

S.No.	No. of participants	Date
1.	112	18 th Sept., 2018
2.	150	19 th Sept., 2018
3.	150	20 th Sept., 2018
4.	179	21 th Sept., 2018
5.	144	24 th Sept., 2018
6.	157	25 th Sept., 2018
7.	151	26 th Sept., 2018
8.	125	27 th Sept., 2018
9.	58	28 th Sept., 2018



2.7.3 Literature Development & Distribution

Literature related to CRM from Haryana kheti were distributed among the villagers and student's creation of awareness as well as to develop confidence. Extension literature provided by ATARI, Ludhiana along with this pamphlet were provided to all the trainees during training programme.



2.7.4 Participation in State Level Workshop

KVK Scientists and farmers from selected villages took part in state level workshop on awareness on In-situ crop residue management organized by ICAR-ATARI, Jodhpur in collaboration with CCS HAU, Hisar on 10th August, 2018. Resource person lectures were organized in this workshop on CRM and a healthy discussion between resource person and farmers was also organized to provide appropriate answer of queries and doubts of the farmers across the state on In-situ crop residue management.

2.7.5 Participation in Kisan Mela

KVK Kaithal ensured participation of the farmers from selected villages in Rabi Kisan Mela organized by CCS HAU, Hisar on the theme of In-situ CRM. Dr. T. Mohapatra, DG, ICAR was the chief guest of this mela. Farmers were benefitted from expert lectures on In-situ CRM and demonstrations of CRM machinery. Along with this, KVK Kaithal also organized a Kisan Mela on In-situ CRM at KVK on 31st December, 2018. In this Kisan Mela, 600 farmers from selected as well as nearby villages participated and got knowledge about In-situ CRM under Rice-Wheat cropping system.



2.7.6 Conductance of Demonstrations

Demonstrations on wheat sowing by Zero-Tillage Drill, Happy Seeder and Rotavator were conducted in Hajwana, Kharkan, Kural, Barot, Patti Afgan etc. out of these 124 demonstration plots were conducted in Hajwana and Rasina village performance of wheat crop in these field one quite satisfactory.



2.8 KVK, Kurukshetra

To enrich the knowledge and create awareness among the farming community of the district, this centre has taken number of activities with regards to CRM.

2.8.1 Organisation of Farmers Training

KVK has organized training of farmers of 7 blocks of Kurushetra district for 6 days. As much as 880 farmers were trained on different aspects of CRM. Apart from that more than 150 farmers who have holding the Custom Hiring Centres in the district have also been trained with respect to different type of machineries used in the crop residue management.



2.8.2 Training in Adopted Villages

KVK, Kurukshetra has adopted two villages i.e. Barna and Kamoda for promotion of agricultural for In-situ management of crop residue in the district. Two trainings of 25 farmers each were conducted of five days on CRM. During the training resource person lectures were delivered by the different scientists on ill effects of crop residue, management of different techniques, use of different machinery along with the live demonstrations of different machinery and the technology in the field itself.



2.8.3 Organisation of Farmers-Scientists Interface

Two FSIs particularly from the adopted villages of Barna and Kamoda were organized during the quarter under period and different issues of crop residue management were discussed with the farmers in detail. Apart from that 6 farmer's scientist's interactions were also arranged in district Kurushetra in collaboration with the Department of Agriculture and Farmers Welfare and as much as more than 500 farmers took active part in these programme.



2.8.4 Organisation of Progressive Farmer Club Meeting

KVK, Kurushetra organized 4 progressive farmer club meeting in the month of September, October, November, December 2018 in the KVK Premises and thorough discussion with regards to problems in handling CRM machinery, feedback was discussed and their queries were resolved by the participating scientists.



2.8.5 Conductance of Demonstrations

This centre has organized demonstrations in both the adopted villages on different existing practices of CRM at the farmers' fields. The machineries like zero tillage, happy seeder were also provided by this centre to the farmers of these villages.



2.8.6 Organization of Kisan Mela

A huge Kisan Mela was organized by KVK Kurushetra on 26.11.2018 in village-Barna. The mela was attended by more than 1200 farmers and farm women along with other departments. Hon'ble Governor of Himachal Pradesh, Sh. Dev Vrat Acharya Ji was the chief guest of this occasion. Exhibitions were displayed in the Mela.

The scientists of this centre took active part in the 6 Kisan Melas organized in the district by the Department of Agriculture and Farmers Welfare particularly on crop residue management. These melas were organized in each block in which more than 1000 farmers in each mela took active part and a large exhibitions showing different machineries used in crop residue management was displayed.



2.9 KVK, Panipat

As the CRM technologies involve the use of new machines and also involve paradigm shift in the component technologies with respect to nutrient management and the management of insect-pest and diseases, the capacity building of the all stake holders is a condition precedent to achieve success. KVK Panipat made vigorous and concerted efforts and number of activities for the capacity building in two CRM villages and also in the rest of the district.



Field Visit for In-Situ Crop Residue Management by M. S. Meena (PS) ATARI, Jodhpur at KVK, Panipat

2.9.1 Organization of Training Programmes

KVK, Panipat conducted 2 five-day training programmes which were attended by 50 farmers (25 from village Kaith and 25 from village Urlana each). In addition to this 7 training programmes of one-day duration were also organized which were attended by 770 farmers. KVK conducted 118 demonstrations on CRM technologies covering area of 118 ha. The crop condition is very good in all these demonstrations. KVK Organized 15 awareness programmes on various



aspects of crop residue management technologies which were attended by 1403 farmers. KVK also organized five training programmes for the Department of Agriculture and Farmer Welfare, Panipat which were attended by 535 farmers.

2.9.2 Organization of Kisan Mela

One Kisan Mela was also organized in its campus on 05.12.2018 and the same was attended by 650 farmer's/farm women and this KVK participated in 2 kisan melas being organized by the Department of Agriculture and Farmer Welfare, Panipat. KVK organized one 'In – Service' training programme for the officers of Department of Agriculture and Farmer Welfare, Panipat and the same was attended by 60 officers. In order to monitor the project activities particularly the demonstrations, 12 field visits were undertaken.



Kisan Mela at KVK, Panipat

2.10 KVK Rohtak

The basic purpose of KVK is to impart need based training for capacity building of the farmers and farm women of district. Training is the capacity building process for practicing farmers and farm women and a first-hand dissemination of skill and technical knowhow for its further implications. The present project “Promotion of Agriculture Mechanization for In-situ Management of Crop Residue” is an excellent initiative by the government to aware the farmers of major rice growing states about the harmful impacts of crop residue burning and benefits of crop residue management.

2.10.1 Training of KVK Scientists

Two days training program organized by PAU, Ludhiana regarding different methods of crop residue management and proper working, handling and maintenance of CRM machineries was attended by two KVK scientists (Dr. Rajesh Kumar and Dr. Meenakshi Sangwan). To disseminate this technical know how to the farmers various activities and trainings were organized by KVK scientists.

2.10.2 Training Organised for Farmers'

Two five-days training programs and 6 one-day training programs were organized by KVK, Rohtak to aware rice growing farmers regarding ill effects of residue burning and sustainable methods for crop residue management. Two five-days training programs were organized at KVK premises for 50 farmers of two selected villages. One training was organized in the direction of Dr. Meenakshi Sangwan, DES (Agronomy) and another was organized in the direction of Dr. Rajesh Kumar, DES (Entomology). Farmers were motivated by Dr. Meena siwach (Senior Coordinator) regarding crop residue management. Every day resource person lectures regarding impact of crop residue burning on environment, living entities, soil health and benefits of sustainable crop residue management on soil health, effect on weed flora in wheat, how to manage insect-pest and disease in CRM fields, use of paddy straw in compost preparation for mushroom production, nutritive value of paddy straw as animal fodder, description of various machineries for crop residue management, care and maintenance of straw management. machinery for better performance, benefits of zero till sowing of wheat as compared to conventional sowing, success stories of farmers for in situ crop residue management etc. were delivered



to the farmers. There were machinery demonstrations during the training program. Deputy Director of Agriculture (DDA) and Assistant Agriculture Engineer (AAE) from State Department of Agriculture were also involved to provide necessary information on schemes & subsidies on CRM machinery and on Custom Hiring Centre establishment to the farmers, Govt. laws to control crop residue burning and its harmful effects, proper operation and handling of paddy straw management machinery. In collaboration with state department of agriculture, Rohtak, six trainings were organized by KVK, Rohtak and 328 farmers from different villages of district get benefitted from these. Farmers were trained about health hazards of crop residue burning, impact of burning on soil health and beneficial effects of residue management in soil health and environment. Description and demonstration of various mechanisms were displayed and discussed with farmers. Success stories of farmers on in-situ crop residue management were shown to farmers. In the end of each training, there was buzz session for farmers regarding in-situ management of residue. Farmers in the house pledge to refrain from stop burning.



2.10.3 Participation in State Level Workshop

KVK Scientists and 10 farmers from selected villages were participated in State Level Workshop on “Awareness on In-Situ CRM” organized by ICAR-ATARI, Jodhpur, in collaboration with CCS HAU, Hisar on 10th August, 2018 at CCS HAU, Hisar. Interactive lectures regarding CRM were delivered in workshop. There was discussion (Q/A) session between scientist/resource person and farmers during the workshop on crop residue management.



2.10.4 Organization of Farmers-Scientists Interface

Two FSI were organized at two selected villages (Sanghi and Bainsi). About 150 farmers participated in FSI (75 farmers in Sanghi and 75 farmers in Bainsi) and they get acquainted with benefits of sustainable crop residue management. There was healthy two-way discussion between scientists and farmers about sowing methods, germination percentage in different sowing methods, problems during use of machineries in field. What could be the possible alternatives of burning of crop residues.



2.10.5 Organisation of Kisan Mela

KVK scientist and farmers from selected village of Rohtak district were participated in Rabi “Kisan Mela” organized at CCS HAU, Hisar on “Promotion of Agricultural Mechanization for In-Situ CRM”. Dr. T. Mohapatra, DG, ICAR was the chief guest of mela. Along with this, KVK Rohtak also organized a Kisan Mela under the scheme “Promotion of Agriculture Mechanization for In-situ management of crop residue” at KVK premises on 29.12.2018. 625 farmers of district attended “Kisan Mela”. They were made aware about crop residue management methods and various technologies were displayed in the exhibition on agriculture and allied activities. Dr. R.S. Malik, Research Officer (Soil science), Department of Agriculture and Food, Western Australia grace the occasion and motivate the farmers to manage the crop residues and change cropping system wherever to possible for soil health management. Different resource persons from State Department of Agriculture, State Department of Animal Husbandry, Scientist from Pashu Vigyan Kendra (PVK), State Department of Horticulture, State Irrigation department, Soil Conservation Officer etc. were actively participated and delivered lectures regarding in-situ crop residue management, schemes in Agriculture Department.



2.10.6 Conductance of Demonstrations

Hands on Trainings were given to the farmers on use and operation of straw management implements and about prevention of crop residue burning in selected villages. 10 agricultural CRM machineries viz three zero till drill, two happy seeder one chopper cum mulcher, one paddy shredder, two cutter cum spreader, one hydraulic reversible MB plough etc. were given to farmers of two selected villages for their use in rice field to manage residue. Inputs (Seed, fertilizer and herbicide) were demonstrated 250 farmers of selected villages. Technical and scientific guidance demonstration of sowing of wheat after in-situ management of paddy residues through suitable combination of machinery were given.



2.10.7 Literature Published and Distributed

Articles on crop residue management were published by KVK, Rohtak in both Hindi & English languages in various reputed magazines. A pamphlet was also prepared by KVK, Rohtak which covers all the aspects including current scenario, ill effects, benefits and sustainable methods of in-situ crop residue management and detail wise features of CRM machinery. Extension literature provided by ICAR-ATARI, Ludhiana along with this pamphlet were given to all the participants in each training and other programmes.

2.11 KVK, Sonipat

KVK, Sonipat has been included in central sector scheme on “Promotion of Agricultural Mechanization for In-Situ Management of Crop Residue”. A total fund of Rs. 29.14 lakh was sanctioned to implement different activities including awareness of farmers through trainings, FSI, Conduction of FLDs on straw management machines. For this purpose, two villages Moi & Kheri Damkan have been selected by KVK Sonipat. In these villages two trainings were organized one from each selected village at Krishi Vigyan Kendra, Sonipat. In each training, 30 progressive farmers from different land holding groups *i.e.* marginal, small and medium were selected as trainees.

2.11.1 Organization of Training Programmes

During five days' trainings each and every topic related to paddy straw management technologies was covered. KVK scientist, scientists from CCS HAU, other KVK scientists and officers from State Agriculture Department delivered interactive lectures on ill effects of paddy straw burning on soil health and environment, In-situ use of paddy straw management machinery for direct sowing of wheat, formation and execution of custom hiring centres (CHCs) on straw management machinery, care & maintenance of straw management machinery for better performance, Agri-entrepreneur development with CHCs, role of CRM machinery for generating additional income, adoption of agronomic practices during crop residue management, efficient use of straw management machinery, weed management in direct sowing of wheat, proper operation and handling of paddy straw management machinery, comparing economics of direct sowing of wheat with conventional sowing, role of women farmer in crop residue management, use of waste de-composer in paddy straw management and judicious use of straw management machinery. Sixty farmers from these two selected villages were trained and also provided some inputs in the form of T-shirt & carry bag having slogans on paddy straw management “Parali Na Jalao Vatavaran Ko Bachao”. These farmers were also provided seed and weedicide for conduction of front line demonstration on straw management machinery to show the role and real impact of these machines on paddy straw management.



2.11.2 Organization of Farmers-Scientists Interface

Two FSI were organized, one in each village to motivate the farmers to adopt these technologies and sorted out the doubts of farmer about the execution and implementation of this project. Farmers of these villages respond well for adoption of these technologies at their fields and also assured to motivate

other farmers to adopt these technologies for the benefit of human being, environment, soil, water, flora and fauna.



2.12 KVK, Yamunanagar

Under the central scheme, “Promotion of Agricultural Mechanization for In-situ Management of Crop Residue”, KVK Yamunanagar performed the various activities to create awareness among farmer/farm women towards harmful effects of crop residue burning and how it can be prevented through sustainable means. Various programme & activities including training, awareness campaigns, press notes, travelling seminar/rally on bicycles, Farmer Scientist Interaction, Kisan Mela etc. were conducted to create awareness, sense of belongingness and responsibility towards saving of precious soil and environmental resources through sustainable crop residue management. In total 4608 farmer/farm women benefitted from these programme & activities.

2.12.1 Awareness Cum Training Programmes

Training program by KVK, Yamunanagar team headed by Dr. B R Kamboj on In-situ Crop Residue Management through mechanization was organized at KVK premises on 23/7/2018. The stress was laid on demonstrating Happy seeder as viable option residue management in rice-wheat, which is the main cropping system adopted by majority of the farmer. Dr. Kamboj informed about the many benefits like water saving, fuel saving and time saving by direct drilling of wheat in rice stubbles using Happy seeder. Practical demonstrations were organized on the Happy seeder machine, precautions to be observed while operating the machine in the field and necessary requirement for smooth running of machinery. Farmers of Yamunanagar district pledged to never



burn crop stubbles in their farm in presence of KVK, Yamunanagar team. They also viewed to act as extension agents to spread this message to more and more people. The training ended with by soil health management issues by Dr. N. K. Goyal (Sr. ES Soil Science) who also persuaded farmer not to burn residues in their paddy fields and told that these small steps converts to mass campaign which is the need of hour.

2.12.2 Participation in Awareness Programme

KVK, Yamunanagar also participated in block level awareness program on CRM in Sadhora Block Yamunanagar when conducted on August 2, 2018 in collaboration with State Agriculture Department. 490 farmers participated in this event. Few issues were raised by famer regarding difficulty in managing weeds in zero tillage (ZT) situation for which suitable advisory like stale bed techniques, application of broad spectrum pre and post emergence herbicide was issued by the KVK team members.



Awareness program at KVK, Yamunanagar

2.12.3 Participation of Scientist in Training Programme

Scientific staff from KVK, Yamunanagar also participated in two-day training program on In-Situ CRM held at PAU Ludhiana from 6-7 August, 2018 and organized by ATARI Ludhiana for capacity building of KVK staff involved in Crop Residue Management Project. New intervention in machinery like spatial ZT drill, super SMS in combine machine, wet and dry mixing of rice residue were demonstrated to manage paddy residues in the field. Exposure visit to Happy Seeder manufacturers were also arranged to provide first-hand experience of crops residue machinery.



Farmer-Scientist Interface at KVK, Yamunanagar

Farmer's awareness cum training program on CRM by KVK, Yamunanagar team was also organized at Bahadurpur village on 29th August, 2018. Farmers viewed that there is very short window between harvesting of paddy and sowing of wheat, that's why farmers prefer burning stubbles which leads to depleting soil nutrients besides causing pollution. Various options to manage paddy residue without burning were advocated to the farmers. Also health issue of soil due to burning stubble was also discussed with farmers.



2.12.4 Organization of Farmers-Scientists Interface

Farmers-Scientists Interactions on issues, problems and opportunities in transforming from conventional sowing to conservation agriculture based sowing without burning crop residues was held at village Dhouli, by KVK Yamunanagar. This interaction was held under Central Sector Scheme “In situ CRM” started this year with the objective of prevention of stubble burning in farmer field. Under this scheme, seed of improved wheat variety was demonstrated in farmer's field who opted for wheat sowing with Happy Seeder without burning crop stubbles. Besides paddy stubbles, KVK have demonstrated wheat sowing by Turbo Happy seeder in sugarcane trash too.



Training cum capacity building on crop residue management in collaboration with State Agriculture Department was organized at KVK campus in total 11 batches comprising of 545 farmers. In this programme, farmers from different blocks of Yamunanagar district were sensitised about harmful

effects of stubble burning and machinery options to successfully manage by KVK Yamunanagar team. Each day programme started with interactive lectures by KVK staff along with State Agriculture Department officials followed by hands on training on actual use of various machinery in field conditions by KVK team.

2.13 KVK, Sirsa

KVK, Sirsa selected two villages viz; Umedpura and Mallewala under CRM Project. KVK scientists visited the villages and collected basic information about the two villages, cropping pattern, area under various crops, sowing methods, sources of irrigation etc. and found that straw burning on considerable scale was practiced last year. KVK organised meeting with the involvement of village panchayat and discussions on several issues related to burning of stubble were done. Farmers were told about harmful effect of residue burning.



Some of the farmers agreed with the KVK scientists but some raised queries on this issue. KVK organised three goshies in each adopted villages in which large number of farmers participated. The queries of the farmers were replied by the scientists. Out of the village 25 farmers were selected and five-day training was imparted to them by the KVK scientists. These farmers were trained by experienced resource persons from KVK Sirsa and other institutes. Modern implements for residue management were demonstrated to the farmers during the training. These 25 farmers have been assigned the method demonstration work to other farmers of the villages as well as adjoining villages so that they might be convinced with the residue management practices. Krishi Vigyan Kendra also trained 752 farmers from all over the district and covered whole district where residue burning was major threat. These 752 farmers were trained in collaboration with Agriculture and Farmers Welfare Department of Sirsa.



2.13.1 Organization of Kisan Mela.

A Kisan mela was organised by Krishi Vigyan Kendra Sirsa in the month of November 2018 in which 1100 progressive farmers from all over the district participated. These farmers were told about harmful effects of residue burning on soil health as well as human health and also told that the farmers increase the organic carbon content of the soil by applying and mixing the residues inside the soil. They



were also advocated that increasing or maintaining the organic carbon content of the soil was first and important step towards conservation agriculture which was need of the time.

2.14 KVK, Karnal

In Haryana, Karnal is known as a major paddy growing district. Farmers used to burn the paddy stubble in a run-up to wheat sowing leading to the degradation of soil health and environment pollution. KVK NDRI Karnal implemented the project “Promotion of Agricultural Mechanization for In-Situ Management of Crop Residue in the States of NCT Delhi and Haryana” with the funds provided by ICAR. In this project, this KVK purchased two happy seeders (10 tines), One hydraulic reversible MB Plough (2 bottom), two shrub master, two mulchers (6 ft) and three zero till seed cum fertilizer drill (13 tines) to arrange demonstrations on In-situ management of paddy straw, as per the directions from ICAR.



Demonstration at KVK, Karnal

KVK was able to demonstrate the In-situ management of paddy straw with the help of mulcher, shrub master and hydraulic reversible MB plough. With the help of happy seeder and zero tillage the sowing of wheat was demonstrated in three adopted villages Dabri, Kunjpura and Kulwehri of Karnal district during rabi 2018-19. Overall performance of wheat in quite satisfactory.



Kisan Mela at KVK, Karnal

2.15 KVK, Delhi

2.15.1 Awareness-Cum Training Programme

KVK Delhi, organized Awareness Cum-Training Programme in adopted Village (Ghumanhera) on 05th July, 2018. Dr. M. Hasan, Principal Scientist (Farm Machinery), ICAR-IARI was resource person of this programme and Programme Coordinator, KVK briefed objective of crop residue management and he also focused about harmful effect of crop burning for soil properties, structure, environment and human health. Dr. Hasan delivered interactive lecture on farm machineries efficacy for *in-stu* paddy crop residue management. Dr. Hasan also informed to the famers about the rice residue management in field as incorporation of residue in the soil and use as mulch it can conserve soil moisture, save irrigation and after decomposition helps in improving the physical, chemical and biological fertility of soil. During the cropping season, KVK team regular conducted awareness campaigns and Field visited in different villages (Sarangpur, Dansa, Galibpur, Ghumenhera, Rawta, Jhuljhuli, dhorala in Najafgarh Block and Palla, Sungerpur, Tigipur village in Alipur Block) for spread of awareness message to farmers about harmful effect of crop burning for soil properties, structure, environment and human health. In these programme opined to farmers on importance of in-corporation crop residue by farm machineries and scientists also farm machineries for use In-situ crop residue management and importance *In-situ* crop management practices on soil physical, chemical and



Awareness Programme at KVK, Delhi

biological fertility in reaction to crop production and productivity. About more than 300 farmers and farm women were participated in these programmes (Table 2.15.1).

Table 2.15.1 Details of Awareness Programme of Crop Residue Management

S.No.	Date	Venue of Programme	Participants
1.	05th July, 2018	Ghumanhera	61
2.	25 th July, 2018	Sarangpur	25
3.	30 July, 2018	Dansa Village	30
4.	10 August, 2018	CCSHAU, Hisar	14 lead farmers
5.	20-21 August, 2018	Sungerpur and Tigipur Village	60 Farmers
6.	19 September, 2018	Sungerpur village	40 Farmers
7.	20 September, 2018	Palla village	30 Farmers

2.15.2 Training Programme

In this training programme farmers were well trained on importance of In-situ crop residue for soil health and properties, harmful effect of paddy burning on soil health, micro-organism, environment and human health. During the programme also focused on use of paddy straw for animal fodder, use for preparation of vermi-composting and mushroom production, improve soil fertility and productivity by conservation mechanization.

During the training programme farmers were well trained by method demonstration and literature were provided on operational guidelines of farm machineries for *in-situ* crop residue management and importance *In-situ* crop management practices on soil physical, chemical and biological fertility in reaction to crop production and productivity.



Farmers training programme at KVK, Delhi