decreases soil loss and preserves the productivity of land. The growing of same crop year after year depletes the soil minerals. Use of legumes in crop rotation maintains the fertility of the soil.

Strip cropping : It is a system of crop production in which long and narrow strips of erosion resisting crops (close-growing crops) are alternated with strips of erosion permitting crops (erect-growing crops). The strips are laid across the slope. Strips of close-growing crops reduce the transporting and eroding power of water by forming obstruction to run off and filter out the soil from the runoff and retain it in the field.

Trash farming : It is a technique of soil conservation where chopped crop residues are spread and ploughed in order to produce a better tilth in the soil.

Cover crops : Cover crops are the crops grown to cover the soil during off-season. Certain cash crops like peanuts cotton, soyabean etc. do not produce enough residue to provide adequate ground cover. Cover crops usually legumes are used to provide the needed protection against erosion and also add nitrogen to soil.

Dry farming : This practice is useful for croplands grown in low and moderate rainfall areas, where ordinary farming is at risk. Crop production, animal husbandry and growing grazing fields are the only possibilities of checking erosion. Some of them are land fallowing, strip-cropping, crop rotation etc.

Chemical measures: Breakdown of aggregate by the falling rain drops is the main cause of detachment of soil particles. Soils with stable aggregates resist break down and thus resist erosion. Aggregate stability can be increased by spraying chemicals like Polyvinyl alcohol at 480 kg ha^{-1}, the rate, however, depends on the type of soil. Soils treated with Bituminincrease water stable aggregates and infiltration capacity of soil.

Mechanical measures: The mechanical measures are adopted to supplement the agronomical measures when the later alone are not adequate. These measures include Basin listing, Sub-soiling and Contour terracing.

Basin listing : It is constructing of small basin along the contours to retain water which also reduces its velocity. It is especially effective on retentive soils having mild slopes.

Sub-soiling: This method consists in breaking with a subsoiler the hard and impermeable subsoil to conserve more rain-water by improving the physical condition of a soil. This operation promotes greater moisture penetration into the soil, reduces both run-off and soil erosion.

Contour terracing : It is constructing a channel along the slope to intercept or direct the run off water. This may be :

– *Channel terrace* : To dig channels at suitable intervals and the excavated soil deposited as a wide, low ridge along the lower edge of the channel.

– *Broad based ridge terrace* : To construct ridge along both the sides of the channel; and

– *Bench terrace* : To construct a number of platforms along contours or suitable graded lines across the slope.

Forestry measures: Afforestation of eroded lands is best method of erosion control. The standing vegetation and dried leaves on the floor intercept the rain and reduce the impact of rain drops. Thus averting the erosion process. Moreover, the decomposition of fallen dead plant parts *i.e.* leaves and twigs not only increase the fertility of the soil but also improve the soil structure, which resist the soil erosion.

Agrostologicalmeasures : Grasses are helpful in control of soil erosion, hence they are used as erosion-resisting plants. Grasses are grown in strips between the crops. Agrostological measures include :

– *Lay farming* : This aim to grow grasses in rotation with field crops, which helps in building up the structure of soil and improving its fertility and

– *Retiring lands to grasses* : It involves to grow grasses on such lands where major proportion of the top soil has been eroded. Generally grasses are allowed to grazing under suitable climate conditions.

Other measures: These include:

– *Gully control*: To check the formation or widening of gullies by constructing bunds, dams, drains or diversions through which excess run off water is channelled.

– *Stream bank protection*: To grow vegetation alongside the river bank, to construct drains, concrete or stone pitching etc. For checking the cutting and caving of river banks

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Awareness of scientific information for management to control pink boll worm by various training programme

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In Amreli district, cotton, groundnut, sesame, wheat, *Bajra*, castor, sorghum and pulses are main field crops. The project aimed to aware farmers about integrated pest management practices (IPM) to control pink bollworm pest attacking in cotton crop. In Amreli district, majority of farmers are grown cotton in their field. Between last three to four years, attack of this pest became very serious, which leads to heavy loss of yield. Awareness about integrated approach was necessary due to mono cropping situation in Amreli district.

Pectinophora gossypiella is a very destructive, cosmopolitan pest and the most serious lepidopteran pest of cotton. Female moths lay eggs on cotton plants, and larvae bore into cotton bolls where they eat cotton seeds. Larvae do not move from plant to plant and they overwinter in diapause. For the cotton farmer, there is a problem of pink bollworm of cotton in Amreli district whose crop has been damaged due to an unforeseen and severe attack by the pink bollworm (*Pectinophora gossypiella*) pest during *Kharif* season.

The pink bollworm had developed resistance to Bt cotton at different villages of Amreli districts. "Pink Bollworm pest, which causes failure of buds to open, seed loss and damage to the lint, was covered in large area which causes great loss. Farmers are awared by importance of IPM practice. *i.e.* cultural practices (shredding of diapausing larvae during the winter in cotton residues), cultivating non-Bt variety cotton as a refugia, mating disruption with the PBW sex pheromone. Alternate spraying of *Neem* oil with systemic insecticides, Timely sowing of cotton, reduces ratooning and selection of early mature variety.

The pest has also attacked cotton in a few villages in Amreli district where the scientists have made studies.

Plan, implement and support: An awareness programme in Amreli district by Krishi Vigyan Kendra, Junagadh Agricultural University, Amreli was taken, which was supported by ATMA, State department and NGOs; for organizing training programme about IPM of pink boll worm in cotton crop.

Advance planning was made and implemented strategies to control pink boll worm by using various IPM tools like bio-pesticides, mechanical devices and also provided valuable information for management of pink bollworm. Proper literatures like folders, pamphlets, leaf lets, text messages and audio-visual aids were provided to the farmers.

Farmers of Amreli district were benefited by scientific and technological information about IPM of pink boll worm and necessary guidance was also provided by scientists of Krishi Vigyan Kendra, Junagadh Agricultural University, Amreli (Gujarat). Scientific information about IPM of Pink bollworm was provided by scientist through various training programme are as under:

Table 1 : On campus training courses organized for awareness

Date of training	Title of Training	Duration (Days)	No. of participants	Types of participants
01/06/2016 to 02/06/2016	Importance of Pheromone for monitoring infestation of pink bollworm in cotton	2	23	Progressive farmers

Table 2 : Off campus training courses organized for awareness

Date of training	Title of training	Duration (Days)	Village	No. of participants	Types of participants
04/05/2016	Management of pink bollworm in cotton	1	Amba (Liliya)	62	Progressive farmers
05/08/2016	through integrated approach	1	Venivadar	56	Progressive farmers

Table 3 : Sponsored training courses organized for awareness

Date of Training	Title of training	Duration (Days)	No. of participants	Sponsored agency	Village
18/06/2016	Detail	1	45	ATMA	Ingorala (Lathi)
21/06/2016	information	1	30	State Department	Nesdi (Savarkundla)
13/07/2016	on Various	1	30	State Department	Amreli-Keria Road
16/07/2016	practices for	1	30	State Department	Khijadiya-Radadiya
25/07/2016	management	1	90	ATMA	Khakhariya (Babra)
29/07/2016	of pink	1	135	ATMA	Bantwa Devali (Kukavav)
9/08/2016	bollworm in	1	75	Reliance Foundation	Sukhpur (Babra)
23/08/2016	cotton	1	200	ATMA	Balel Pipariya (90) and Babra (110)
30/08/2016		1	40	State Department	Chakkargadh (Amreli)

Table 4 : Lecture on awareness among the farmers to control pink bollworm in cotton

Date of training	Duration (days)	No. of participants	Village
05/04/2016	1	597	PFBYs -Programme
09/04/2016	1	50	Juni Haliyad
11/05/2016	1	125	Shilana,Juni Haliyad
13/05/2016	1	48	Karjala
7/06/2016	1	52	Ditla
14/06/2016	1	65	Mota Bhandariya
10/08/2016	1	56	Bambhaniya
12/08/2016	1	20	Ditla and Lakhapadar
30/08/2016	1	15	Sukhpur (Dhari)

Table 5 : Lecture on awareness among the farmers to control pink bollworm in cotton at farmer training centre-Amreli

Date of training	Duration (days)	No. of participants	Village
03/08/2016	1	68 (Female)	Dahida and Shekh Pipariya
08/08/2016	1	130	Mota Liliya and Pipalia
19/08/2016	1	71	Thordi and Mota Bhamodra
29/08/2016	1	65	Rugnathpur and Lunghiya

Output : Due to providing knowledge of scientific package of practices and technologies to farmers by various training programmes, farmers are aware about various benefit of modern and scientific approach to control pink boll worm through utilization of bio-pesticides and mass trapping of pink boll worm adults by mechanical devices like pheromone trap and this reduced the application of hazardous pesticides and also farmers started use of bio materials for control of pink bollworm which was purchased from Krishi Vigyan Kendra, JAU, Amreli at very nominal prices as compared to marketed rate which was produced as Savaj brand at Bio control Lab, JAU, Junagadh.

Outcome : Used of several bio-products were promoted through various informations provided by scientists of Krishi Vigyan Kendra. It created demand in market and accepted the use of bio-product like *Beauveria bassiana*. Till today, most of the farmers used the hazardous chemical for spraying on the crop, which are harmful to the crop, by this awareness programme, farmers uses bio-products, which are available at very cheaper rate and not harmful to the crop. Now a days, they are using bio-products like *Beauveria bassiana*, which is available from Krishi Vigyan Kendra, Amreli at the rate of Rs. 150 per kg. From 1 kg of this bio-product, 12 pumps can be sprayed at the rate of 80 g per pump. Due to the awareness programme, 2475 farmers get benefitted. It was also

Table 6 : Revenue generated through selling of bio-products (year: 2016-17)

Bio-product	Sold Qty.	Rate / Unit	Benefitted farmers	Value
Beauveria bassiana	17000	150	1450	25,50,000
Pheromone trap	7050	20	540	1,41,000
Gossy Lure	8500	20	485	1,70,000
Total			2475	28,61,000

observed that during year: 2017-18 (cotton season) most of the farmers trained had used these bio-products for control of pink boll worm.

Impact : Due to organizing various training programmes and lectures in sponsored training programmes, farmers have started used of bio pesticides like *Beauveria bassiana, Metarhizzium anisopliae*, Azadirechtin and bio fertilizers in their field of cotton and another field crops also. It created high demand in market of bio-products. Finally, Bio pesticides and bio products are economic and eco friendly will helps to the farmers in upcoming years on economical as well as social platform.

Feedback of farmers:

– Bio-products are effective and can get cheaper rate.

– Bio-products are not harmful to crops and environment.

– It is easy to apply.

– Scientific knowledge and information are always helpful for farmers to reduces cost and increases yield of crops.

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