



**INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,
BENGALURU**



**EVALUATION OF RKVY PROJECTS
OF
UNIVERSITY OF AGRICULTURAL SCIENCES,
RAICHUR**

**ESTABLISHMENT OF PESTICIDE RESIDUES ANALYSIS
LABORATORY IN HYDERABAD KARNATAKA REGION**

**INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,
#15, QUEENS ROAD, BENGALURU 560 052**

ESTABLISHMENT OF PESTICIDE RESIDUES ANALYSIS LABORATORY IN HYDERABAD KARNATAKA REGION

EXECUTIVE SUMMARY

Moving towards a sustainable global food system will become more difficult as global population increases. A common perception is that global food supply is currently sufficient to feed the world's population, with timely distribution required to avoid hunger (World Hunger Organisation, 2016), but that food production must increase dramatically in the next decades (Food and Agriculture Organisation of the United Nations, 2009) as global population increases to ≈ 9.7 billion in 2050 (United Nations Department of Economic and Social Affairs, 2015). However, the challenge of sustainably producing sufficient food for the growing global population will not necessarily be solved by increases in production.

Food and nutrition security are intimately interconnected, since only a food-based approach can help in overcoming malnutrition in an economically and socially sustainable manner. Food production provides the base for food security as it is a key determinant of food availability. The Indian food industry is poised for huge growth, increasing its contribution to world food trade every year. The country achieved a production level of 284 million tonnes. The food sector has emerged as a high-growth and high-profit sector due to its immense potential for value addition, particularly within the food processing industry.

Efforts at increasing the productivity in Indian farms has led to measures to reduce losses in production through insect pest and diseases and competition from weeds which share the nutrition meant for crop production. Use of pesticides and other chemicals has been the major means of reducing losses through attack by insect pests, diseases and weeds. Use of pesticides has been increasing in recent years as the pests have started developing resistance to the traditional chemicals.

Pesticides are mainly used in agriculture for the prevention, destruction or control of harmful organisms (pests) or diseases, or for the protection and preservation of plant products during production, storage and transport. Their application in agriculture has progressively increased after World War II and became a widespread practice that led to an increase in world food production. While use of pesticides has several advantages like cost effectiveness, timeliness and flexibility, quality, quantity and price of produce, prevention of various problems and protection of pets and humans, their use is also fraught with adverse effects like risk of residues in food, possible health effects at high residue levels, ground water and air contamination, effect of drift of sprays and vapour,

reduction of beneficial species, resistance development by pests and harm to farmer workers and environment. The extensive use of organic synthetic pesticides has resulted in the occurrence of residues of these chemicals and their metabolites in different environmental compartments such as water, soil and also in food commodities in quite small concentrations [Ahmed, 2001].

Global scientific concerns have been raised regarding the potential toxicity of pesticides that have promoted their strict regulation in order to protect consumers, environment and also the users of pesticides. The maximum allowable levels of these residues in foods are often stipulated by regulatory bodies in many countries. Regulations such as pre-harvest intervals also often prevent harvest of crop or livestock products if recently treated in order to allow residue concentrations to decrease over time to safe levels before harvest. Exposure of the general population to these residues most commonly occurs through consumption of treated food sources, or being in close contact to areas treated with pesticides such as farms or lawns (Walter Crinnion, 2009).

MRLs values defined as the highest levels of a pesticide residues that are legally tolerated in or on food or feed when pesticides are applied correctly (adoption of Good Agricultural Practices, GAPs) were established. Each country adopts their own agricultural policies and Maximum Residue Limits (MRL) and Acceptable Daily Intake (ADI).

The control of food safety and quality is an integral part of national programmes for development. National food control systems are designed to protect the health and welfare of the consumer, to promote the development of trade in food and food products and to protect the interests of the fair and honest food producer, processor or marketer against dishonest and unfair competition.

The Government of India regulates the pesticide residues detected in various food items through Prevention of Food Adulteration Act (now through Food Safety and Standards Act, 2005). Various organizations in India have been engaged in monitoring of pesticide residues in food commodities and environmental samples in their individual capacity primarily for academic purposes. Such studies were often overlapping and differed from one another in their results. Due to increasing public awareness and legalities involved in pesticide residues in food commodities, there was a need to harmonize the monitoring of pesticide residues in the country.

During 2009, Lok Adalat which was held in Kalburgi categorically recommended the establishment of pesticide residue analysis laboratory at Hyderabad-Karnataka region by looking into the indiscriminate usage of pesticides and its related hazards on the environment as well as on human beings in the area.

Keeping the above in view, the project, “**ESTABLISHMENT OF PESTICIDES RESIDUE ANALYSIS LABORATORY IN HYDERABAD KARNATAKA REGION**” was taken up by University of Agricultural Sciences, Raichur with Rashtriya Krishi Vikas Yojana funding. The project was implemented during 2015-16. The details of the project are as under:

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| 1. | Title of Project | : | “ESTABLISHMENT OF PESTICIDES RESIDUE ANALYSIS LABORATORY IN HYDERABAD KARNATAKA REGION” |
| 2. | Nodal officer and Principal Investigator | : | Dr. M. Bheemanna, Professor and Head, Department of Entomology, College of Agriculture, University of Agricultural Sciences, Raichur |
| 3. | Implementing Institution (S) and other collaborating Institution (s) | : | Pesticides Residue and Food Quality Analysis Laboratory, College of Agriculture, Raichur |
| 4. | Date of commencement of Project | : | 2015-16 |
| 5. | Approved date of completion | : | 2015-16 |
| 6. | Actual date of completion | : | 2015-16 |
| 7. | Project cost | : | Rs. 35 lakhs |

The objectives of the project are as follows:

1. Development and Standardization of the multi residue analytical method for major insecticides used in cereals and pulses insect pest management.
2. Monitoring of pesticides residues in samples collected from pigeonpea and paddy ecosystem.
3. Spatial sampling of fruits and vegetables from the market outlets and monitoring of pesticide residue in them.

The focus of Evaluation is:

- i. To examine whether the pesticides residue analysis laboratory is strengthened in terms of infrastructural facilities and equipped with required state of art equipment to undertake pesticide residue analysis, heavy metal analysis and food proximate composition.
- ii. To evaluate the impact of establishment of pesticide residue analytical laboratory at the centre.
- iii. To evaluate the impact of pesticides residue analysis experiments in developing MRLs in different field crops.

- iv. To evaluate the utility of pesticide residue analytical laboratory by the various stakeholders.

The process of establishment of the Pesticide Residues Analysis Laboratory was initiated during 2013 and the laboratory started working scientifically from 2016 onwards. Three national projects under Monitoring of Pesticide Residues at National Level sponsored under The Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, All India Network Project on Pesticide residues, Generation of baseline data for heavy metal in leafy vegetables sponsored by FSSAI, Government of India are being implemented by the Pesticide Residues Analysis Laboratory.

The laboratory has obtained accreditation status from National Accreditation Board for Testing and Calibration Laboratories (A constituent Board of Quality Council of India), Government of India for testing 74 pesticide residues in field crops, viz., rice, wheat, sorghum, red gram, black gram, green gram and bengal gram, 72 pesticide residues in fruit and vegetable crops, viz., pomegranate, grapes, banana, mango, sweet orange, guava, tomato, brinjal, okra, green and red chillies, cabbage, cauliflower and capsicum, 7 trace metal elements (lead, cadmium, arsenic, mercury, copper, zinc and tin) in cereals, pulses and its products, moisture, ash, crude protein, crude fat, crude fibre and carbohydrate in rice, rice flour, red gram, red gram dhal and bakery products, viz., biscuits. Range of testing/ Limits of Detection have been prescribed for all tests. The Accreditation Standard is ISO/ IEC 17025: 2005 and is valid for two years from 12/07/2018 to 11/07/2020. The laboratory has developed scopes under the sanctioned project for pesticide residue analysis, heavy metal analysis, food proximate composition, food adulterants and environmental gas estimation.

In United States of America, the pesticide residue monitoring program is a compliance program used by FDA to monitor the level of pesticide chemical residues in domestic and imported foods to ensure that they do not exceed the EPA limits or tolerances. FDA monitors a broad range of foods samples (over 7000 in fiscal year 2016), using a multi-residue method that analyzes approximately 700 different pesticide chemical residues in a single analysis and selective residue methods that detect pesticide chemical residues not covered by the multi-residue method.

Three national projects under Monitoring of Pesticide Residues at National Level sponsored under The Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India are being implemented by the Pesticide Residues Analysis Laboratory. A developed, validated and uniform methodology is followed by all the participating laboratories for sampling, analysis of pesticide residues

and reporting of the results. The results are being confirmed with the help of gas chromatography-mass spectrometry (GC-MS) or liquid chromatography-mass spectrometry (LC-MS).

The projects involve collection samples of food commodities such as vegetables, fruits, cereals, pulses, spices, curry leaves, red chilli powder, milk, egg, fish/marine, meat, tea, etc. from various markets under the Agriculture Produce Marketing Committee (APMC), local markets, farm gate, organic outlets and Public Distribution Systems (PDS) and irrigated water from intensive agricultural fields from different parts of the country and analysis for the presence or absence of pesticide residues.

Totally 190 samples are generated by the laboratory and tested. It has been found that at All India level 2.1% samples were found above MRL as prescribed under Food Safety Standard Authority of India (FSSAI), Ministry of Health and Family welfare, Government of India.

The Pesticide Residues Analysis Laboratory in University of Agricultural Sciences, Raichur has developed and validated the multi residue analytical methods for 74 chemical pesticides used in cereals and pulses. The cereals, pulses, fruits and vegetable samples are being monitored for pesticide content.

For monitoring of pesticides residues in pigeonpea collected from Gulbarga region, about 120 grain samples were collected and analyzed. The pesticide residues were quantified. Similarly, paddy grains were collected from farmer's field during harvest and analyzed for pesticide residue using laboratory developed and validated method.

Similarly, spatial sampling of fruits and vegetables from the market outlets were collected routinely every month and monitored the pesticide residues.

These studies will help in export of quality produce from the region.

The laboratory has prepared and adopted enforcement of quality system documents, viz., quality manual, management system procedures, standard operating procedures and forms and formats that would enable systematic assessment of pesticide residues in selected field crops, fruits and vegetables. Method development and validation for pesticide residues and heavy metal analysis in cereals and pulses, fruits and vegetables and food proximate analysis have been completed by the laboratory which will benefit in residue analysis and food proximate analysis. The laboratory has taken up maintenance and calibration (External and Internal calibration) of analytical equipment (critical and noncritical) for accurate analyses. Critical consumables such as certified reference materials, laboratory reagents and solvents to meet the different analytical requirements

have been procured. The laboratory has generated analytical data by conducting pesticide residues, heavy metals and food proximate analysis by collecting samples from the APMCs and fruit and vegetable markets in the region. From this quality assurance programme including retesting, replicate testing, spike and recovery and use of internal standards have been conducted. This goes a long way in ensuring quality of produce for export in the region.

REFLECTIONS AND CONCLUSIONS

1. All necessary steps to develop infrastructure and procure equipment required for the Pesticide Residues Analysis have been taken and a fully equipped laboratory has been established.
2. All necessary scientists involving various disciplines like Agricultural Entomology, Plant Pathology, Agricultural Microbiology, Processing and Food Engineering, Biochemistry and Biotechnology have been put in place to take up analytical studies.
3. The laboratory has obtained accreditation certificate from National Accreditation Board for Testing and Calibration Laboratories (A constituent Board of Quality Council of India), Government of India for testing 74 pesticide residues in field crops, viz., rice, wheat, sorghum, red gram, black gram, green gram and bengal gram, 72 pesticide residues in fruit and vegetable crops, viz., pomegranate, grapes, banana, mango, sweet orange, guava, tomato, brinjal, okra, green and red chillies, cabbage, cauliflower and capsicum, 7 trace metal elements (lead, cadmium, arsenic, mercury, copper, zinc and tin) in cereals, pulses and its products, moisture, ash, crude protein, crude fat, crude fibre and carbohydrate in rice, rice flour, red gram, red gram dhal and bakery products, viz., biscuits. Range of testing/ Limits of Detection have been prescribed for all tests. The Accreditation Standard is ISO/ IEC 17025: 2005 and is valid for two years from 12/07/2018 to 11/07/2020. The validity needs to be extended.
4. The Pesticide Residues Analysis Laboratory is involved in four National projects, viz., All India Network Project (AINP) on pesticide residues, heavy metal and antibiotic analysis in fruits and vegetables sponsored by Indian Council of Agricultural Research, New Delhi, Monitoring of Pesticide Residues at National Level (MPRNL) sponsored by The Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, Study to generate Baseline Data on occurrence of heavy metal contaminants in vegetables sponsored by Food Safety Standard Authority of India (FSSAI), Ministry of Health and Family welfare, Government of India and creating a protease knockout in E. coli by crelox mechanism to solubilize recombinant proteins sponsored by Department of Biotechnology, Ministry of Science and Technology, Government of India. These have given the laboratory a National Status.

5. The Pesticide Residues Analysis Laboratory in University of Agricultural Sciences, Raichur has developed and validated the multi residue analytical methods for 74 chemical pesticides used in cereals and pulses. Similarly, spatial sampling of fruits and vegetables from the market outlets were collected routinely every month and monitored the pesticide residues. This goes a long way in ensuring quality of produce for export in the region.
6. The laboratory has prepared and adopted enforcement of quality system documents, viz., quality manual, management system procedures, standard operating procedures and forms and formats that would enable systematic assessment of pesticide residues in selected field crops, fruits and vegetables. Method development and validation for pesticide residues and heavy metal analysis in cereals and pulses, fruits and vegetables and food proximate analysis have been completed by the laboratory which will benefit in residue analysis and food proximate analysis.
7. The laboratory has generated analytical data by conducting pesticide residues, heavy metals and food proximate analysis by collecting samples from the APMCs and fruit and vegetable markets in the region. From this quality assurance programme including retesting, replicate testing, spike and recovery and use of internal standards have been conducted. This goes a long way in ensuring quality of produce for export in the region.

ACTION POINTS

1. The objectives of the project have been well implemented and the laboratory is the absolute need of the region since 75 to 80% food grains produced in the region are exported and needs estimation of pesticide residues in order to export. Indeed, this laboratory needs to be upgraded and strengthened by the University for the benefit of farming community in the region.
2. The project should be on PPP mode and generating income on its own for maintenance on long run so that the manpower shortage can be met from generated income.
3. The project should aim at training human resources on use of equipment of sophisticated nature.
4. There is need for convergence of user departments in developing quality standards for the natural resources.
5. The laboratory should display Dos and Donts in the laboratory and all the laboratory equipment and infrastructure developed under RKVY funds should be labelled.
6. All the equipment are well maintained and used. However, there is need to maintain separate deadstock and consumables registers.
7. There is need for training scientists on use of equipment in the advanced areas.

8. Biopesticide residual laboratory may be established.
9. The laboratory can also associate and may be streamlined for food analysis in the region.

RESEARCHABLE ISSUES

1. To work out the cost efficiency and profitability of the technology and its spread.
2. Establishment of centralized laboratory to avoid duplicity of purchasing equipment and chemicals and production of quantitative data besides in convergence through PPP mode of operation.
3. Develop protocols of standards of heavy metals and their safe limits in food grains, vegetables and fruits.