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PESTICIDE RESIDUES IN AGRICULTURAL COMMODITIES IN PAKISTAN'S PERSPECTIVE: WITH REFERENCE TO SAFE LIMITS

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ABSTRACT

In this article a comprehensive review on pesticide residues in agricultural commodities in Pakistan's perspective with reference to safe limits from health point of view is carried out. The consequences of these residues are discussed and future plan and strategies are briefly highlighted to tackle its implication in food chain and to cope up with the WTO requirement to export the agricultural commodities. A concept of net working of laboratory for monitoring pesticides across Pakistan and a need of a regulatory body in the country is also emphasized in this article.

INTRODUCTION

Pesticides continue to be a significant input in modern agriculture and are used for management of pests that are noxious, destructive and often disastrous organisms. Pesticides are chemical substances that kill them. Pesticide may be defined as any chemical for controlling, repelling and mitigating any pest (Oudejans, 1994). In 1938, Paul Müller discovered the insecticidal activities of DDT which opened a new era in pest management both in agricultural and public health sectors (Bealty, 1973). Recent research and development brought about hundreds of new synthetic chemicals of varying toxicity which do benefit the agriculture but they are source which pollute the environment and could have hazards for human health.

In Pakistan pesticides were introduced in 1954 with 254 metric tons of formulation (Kafi & Baig, 1987; Jabbar & Mallick, 1994). By the mid 1960s pesticide consumption had reached over 7000 tons per annum, increasing to the level of 16,226 metric tons (mt) in 1976-1977 (Balouch, 1985). Regulation regarding to food and agricultural of 1965 has not been upgraded for pesticide residues in food up till now (Tariq, 2005). In the agricultural areas of Punjab a tremendous amount of pesticides were used during 1980s to 1990s. It can be evident from the increasing use from 665 mt in 1980 to 45,680 mt in 1999 (Anon., 2000) and recently been reported to be reduced to 25000 mt in 2006 (Anon., 2007).

The long history of higher pesticide applications on cotton growing areas with coarse sandy soil and shallow groundwater has lead to the contaminations of this important source (Jabbar *et al*., 1993; Ahad *et al*., 2001; Tahir *et al*., 2001 and Tariq *et al*., 2004 a, b and 2006). The now have been reporting in Pakistan to be leached down due to various recessions like run off, careless disposal of empty containers, washing of plant protection equipments near the aquatic bodies and etc. (Ahad *et al*., 2000, 2001 Tariq *et al*., 2004a, b and 2006). On occasion's pesticides particularly pyrethroids, are deliberately added to water supplies to control infestations of asellus and shrimps in water. In Pakistan pesticides are being used to trap fishes (Ahad *et al*., 2006).

To prevent adverse effects on public it is a must to establish control measures in order to ensure MRLs to be respected. The pesticides contaminate water, soil and food and accumulate in the soil for relatively longer period of time and then passed into various parts of the plant grown on the contaminated soil. Ahmad (2004) emphasized the continuous monitoring of pesticide residue in our food, environment and biosphere at large and its need for creating awareness of trend of level on contamination and to build up a data base upon which future plan could be decided. The indiscriminate use of pesticides has led to tremendous economic losses and health risk to wildlife and human being. Whereas, human exposure to pesticides is usually estimated by measuring the levels in the environment i.e. soil, water and food (Tahir *et al*., 2001, Ahmad 2004, Anwar *et al*., 2004, 2005 and Anwar, 2009). About 60-70% of pesticide poisoning cases were reported due to occupational exposure and female cotton pickers appeared to be at high risk of hazards (Ahmad, 1998 and Tahir, 2000) and recently Tariq *et al*., (2007) reviewed the pesticides poisoning cases in Pakistan.

Studies conducted in Pakistan: Over the years there had been an increasing concern over the ground water contamination from agricultural chemicals. A detailed review of literature on pesticide residues in water, soil, fruits and vegetables here in order to have a foundation for emphasizing the need of monitoring of pesticides regularly to prevent health hazards.

Water: Jabbar *et al*., (1993) reported pesticides in groundwater drawn from a depth of 30-40 feet collected from the district Samundri. Monocrotophos was detected in three samples in the range of 0.04 to 0.06 ppm, cyhalothrin (in four samples) found in the range of traces of 0.0002 ppm, and endrin was present in three samples in the range of 0.0001 to 0.0002 ppm. While three samples were found free of pesticides.

All pestisticide levels were found to be within the limits set by the FAO/WHO. Ahad *et al*., (2001) determined the pesticides residues in 12 groundwater of Multan division at the depth of 50-180 meter and observed that carbofuran, dichlorvos, phosphamidon, fenvalerate, dimethoate, diazinon, fenitrothion and endosulfan were found at the concentration of 0.26 µg L^{-1}, 0.23 µg L^{-1}, 0.12 µg L^{-1}, 0.09 µg L^{-1}, 0.11 µg L^{-1}, 0.03µg L^{-1}, 0.06µg L^{-1} and 0.13 µg L^{-1}. Anon., (2002) detected pesticide residues from SCARP area of the Punjab, Pakistan in groundwater samples in 2000. Dichlorvos, diazinon, fenvalerate, fenitrothion, lindane were found at the concentration of 0.1 µg L^{-1}, 0.001 µg L^{-1}, 0.08 µg L^{-1}, 0.002 µg L^{-1} and 0.001 µg L^{-1} by GC in 38 water samples. Tariq *et al*., (2004) evaluated pesticides from ground water in four cotton growing districts of Pakistan. Water samples were collected from 37 wells in areas of Bahwalnagar, Muzafargarh, D.G. Khan and Rajan Pur districts of Punjab, Pakistan and analyzed eight pesticides out of which six pesticides were detected. The percentage of detection of bifentrhin, cyhalothrin, carbofuran, endosulfan, methyl parathion and monocrotophos was respectively 13.5, 5.4, 59.4, 8, 5.4 and 35.1% in July; 16.2, 13.5, 43.2, 8%. N.D (not detected) and 24.3% in October. All the pesticides detected were below the Maximum Acceptable Concentrate (MAC) for drinking water as set by USEPA. Parveen & Masud (1988a) reported the residues of chlorinated pesticides and their metabolites in 79 samples of animal drinking water in Karachi, out of which 13% samples were found to be contaminated with OC while, six samples contained γ-BHC in the range of 1.0 to 16.4 ppb. One sample contained p, p'-DDT in traces while two samples had traces of p,p'-DDE. aldrin (2 ppb) and dieldrin (31.5 ppb) detected in one sample. Tahir *et al*., (1999) analyzed the fortified water samples on GC-ECD and calculated the percent recoveries of methyl parathion were calculated to be 100, 67 and 94% at spiking level of 0.17, 1.7 and 8.7 µg L^{-1}. The data showed the evidence that capillary column GC-ECD could be used reliably and advantageously for pesticide analysis. Ahad *et al*., (2006) determined the residues of pesticides in the water collected from Rawal Lake, Islamabad, Pakistan in 2004. Residues of methyl parathion, fenitrothion, azinphosmethyl and alpha-cypermethrin were detected in the concentrations of 0.38 µg L^{-1}, 0.62 µg L^{-1}, 3.3 µg L^{-1} and 5.82 µg L^{-1}. The higher percentage of pyrethroid pesticide residues values were four fold than EEC standards for drinking water.

Soil: Chlorinated pesticides (DDT) residues in soil of Punjab & KPK of paddy ecosystem in Baluchistan have been reported by Baig, 1985). Hussain *et al*., (1988) reported that most of applied DDT was retained on top 5 cm layer in sandy loam soils. It was observed that half life dissipation for DDT in lab was 890 days but under field condition the half life was 110 days in irrigated and 112 days in rain fed soil. Jabbar *et al*., (1993) reported the monocrotophos, cyhalothrin dimethoate, fenvalerate, cypermethrin, profenofos in the top foot soil of Samudari, a cotton growing area. The residue of OC i.e., aldrin, dieldrin, endrin, DDT and its metabolites DDD and DDE were detected in 2-3 ft lower layer of soil. Tahir *et al*., (1999) analyzed the fortified soil samples recoveries on GC-EC and Methyl parathion were calculated to be 100, 67 and 94% at spiking level of 0.17, 1.7 and 8.7 µg L^{-1}. It was concluded that capillary column GC-ECD could be used reliably and advantageously for pesticide analysis. Anon., (2001) reported that 24 soil samples from two depths (1-6 and 6-12 inches) from 6 locations of cotton zone of Punjab were found contaminated with pesticide residues. The fenvalerate, lindane and azinphosmethyl were found higher in lower layer than the top one. While in the lower layers residues of lindane were observed. Tariq *et al*., (2010) studied the fate of pesticides in sandy loam soil of Pakistan at different water table depth. Ahad *et al*., (2010) analyzed the chlorinated pesticide in the soil samples collected from the obsolete pesticide stores from three provinces (Punjab, Sindh and KPK) of Pakistan. A review on occurrence and levels of organochlorine contaminants in the different environmental compartment of Pakistan has been recently carried out by Ali *et al*., (2010). Anwar *et al*., (2012) reported Pesticide residues of organophosphate (OP) and organochlorine (OC) were monitored in soil samples collected from cotton growing areas in Nawabshah district, Sindh. All the 19 soil samples presently analyzed were found contaminated with used pesticides (i.e., dichlorvos, dimethoate, methyl parathion, fenitrothion, endosulfan, mevinphos, chlorpyriphos and profenofos) and the varying degree of concentration and frequency were found in the top soil. The most widely detected pesticide was chlorpyriphos found in 16 samples with mean concentration of 0.486 mg kg^{-1}. Endosulfan was the second most often detected pesticide investigated in 15 samples containing the mean concentrations of 0.426 mg kg^{-1}. Dimethoate was the third most detected pesticide in 14 samples with mean concentration of 0.555 mg kg^{-1}.

Fruit and vegetables: Anon., (1984) conducted a study during 1981-84 on pesticide residues analysis in food items. The food samples collected from local market were categorized under six various heads viz., (1) dairy products, (2) meat, fish and poultry, (3) grain and cereal products, (4) vegetables, (5) fruits and (6) oil, fat and shortening. It was reported that OC and OP pesticides were present respectively in all 48 (100%) and 45 (94%) composites. Individually the residues of malathion in 5 (10%), diazinon in 3 (6.25%), heptachlor epoxide in 3 (6.25%) and endosulfan in one composite(s) were present. Endrin, a banned product, was also

detected in vegetables and all pesticide residues were within permissible limits except dieldrin and BHC which were above the MRL. Masud & Farhat (1985) conducted a survey of wholesale market of fruits and vegetables at Karachi during 1982-83 for OC pesticide residues. Out of 141 total samples analyzed, three fruits and six vegetable samples were found to be contaminated by different chlorinated pesticides like heptachlor, DDT and BHC etc. or their metabolites. Out of 141 samples analyzed the residues of heptachlor and aldrin were found above the MRL in mango and cauliflower samples. Masud & Hassan (1992) monitored the OC, OP and pyrethroids pesticides in fruit and vegetable samples procured from whole sale market of Karachi during 1990 to 1998. About 250 samples were analyzed out of which 93 samples were found to be contaminated with different pesticides and 45 samples contained residues above the MRL proposed by FAO/WHO while 48 samples contained residues within permissible limits. Anon., (1993) analyzed fruits and vegetables of five districts of KPK (Peshawar, Mardan, Swabi, Charsadda and Mansehra), Malakand Agency and Islamabad markets were analyzed for pesticide residues during (1990-91). Two hundred fifty four samples drawn from grower's fields and main selling points were analyzed for the residues of γ-BHC, malathion, methyl-parathion, cypermethrin, decis, tamaron, sumicidin, rapcord, sumethion, hostathion and DDT & its metabolites. About 102 (40%) samples were found contaminated in which 33 (32.35%) samples were exceeding MRLs. Eight pesticides were found exceeding their respective MRLs. DDT and γ-BHC were present in almost all the samples analyzed. Moreover, one sample each of citrus fruit and leaves of apple tree and three samples of vegetables from Gadoon Amazai, KPK were monitored for the residues of methamidophos, benomyl, heptachlor and diazinon but no residues of any pesticide was detected. Masud & Hassan (1995 a) analyzed the fruit and vegetable samples from the growers' fields and main selling points in Quetta/Pishin district of Balochistan during 1992 for pesticide residues. Out of 50 samples 19 (38%) were found to be contaminated in which 1 (5%) was exceeded the MRL. Masud & Hassan (1995 b) monitored 300 samples for fruits and vegetables procured from the grower's field and main selling point of Khyber Packhtoon Khaw (KPK) Province, Islamabad and Quetta/Pishni districts of Balochistan during 1990 and 1992 for OC and pyrethroids pesticides. 121 samples were found to be contaminated while 38 samples contained pesticide residues above the MRL proposed by FAO/WHO. Tahir *et al*., (1999) analyzed the fortified vegetable samples percent recoveries on GC-ECD. It was found that recovery of methyl parathion was found to be 100%, 67% and 94% at spiking level of 0.17 µg L^{-1}, 1.7 µg $L^{-1}$and 8.7 µg L^{-1}.

FAO (2001) reported the presence of pesticide residues in vegetable samples collected form different locations around Multan city. All the vegetable samples analyzed were found to have pesticide residues and 63% samples were found exceeding MRLs for carbofuran, dichlorvos, methyl parathion, fenitrothion and quinalphos methyl, while the pyrethroids, deltamethrin and cypermethrin were not detected in any sample. About 60% apples were found with excess MRL values of carbofuran, while methamidophos, azinphosmethyl and dimethoate residues were also observed.Tahir *et al*., (2001) reported pesticide residues in fruit and vegetable samples collected from Islamabad Sunday markets, Pakistan. The samples were analyzed by capillary gas chromatograph equipped with ECD. Dimethoate was found in the quantity of 0.032 mg kg^{-1} in apple, 0.110 mg kg^{-1} in banana, 0.004 mg kg^{-1} in brinjal, 1.80 mg kg^{-1} in cauliflower and 0.13 mg kg^{-1} in arvi, fenvalerate 0.010 mg kg^{-1} in apple and chlorpyrifos 0.004 mg kg^{-1} in brinjal. Anwar *et al*., (2004) determined the presence of pesticide residue of 6 most commonly used pesticides of OP group (i.e. methamidophos, dimethoate, carbofuran, methyl parathion, malathion and azinphosmethyl). In 9 vegetables (i.e. turnip, spinach, cauliflower, squash, melon, tomato, cabbage and cucumber) purchased from various market places of Mardan city (KPK), Lahore and Faisalabad (Punjab), Pakistan. It was observed that the residues of carbofuran, the most commonly used pesticide on vegetables in Pakistan was only recoded in highest quantities. Hussain *et al*., (2004) reported the pesticide residues in different varieties of mango grown in Pakistan. Parveen *et al*., (2004) monitored the pesticide residues from 270 citrus and apple samples from the different selling points of Karachi, Pakistan, during 1991-2001 by HPLC and GC-FID. It was observed that majority of the samples were contaminated with OC pesticides exceeding the MRLs. Khan (2005) analyzed 608 samples of fruits using HPTLC method from different site of Peshawer, NWFP, Pakistan. It was reported that methamidophos, (9.8%) out of 608 samples, cypermethrin (8.5%) endosulfan (4.9%) chlorpyriphos (4.4%), trichlorofon (3.3%), methidathion (2.8%) and methoxyl (2.6%) and dimethoate (1.8%) depending on the type of insecticide used by grower. Out of 608 samples 250 (41%) contained detectable pesticide residues of which 13.8% exceeded the MRLs. Parveen *et al*., (2005) monitored the pesticide residues in 206 samples of vegetables collected from the different selling point of Karachi, Pakistan, during 2000-2002 by HPLC and GC-FID. It was observed that methamidophos, carbofuran and cyhalothirn were found in 33, 13 and 8 vegetable samples exceeding the MRLs. Hassan *et al*., (2007) analyzed 124 vegetable samples for the pesticide residue of 7 commonly used pesticides. It was observed that 89 vegetable sample were found to be contaminated. Out of which 47 samples exceeded MRLs. Cypermethrin was found in 39 samples, methamidophos in 27, fenvalerate in 22, malathion in 20, chlorpyrifos in 9, endosulfan in 7 and methyl parathion found only in one sample of vegetable.

Anwar *et al*., (2011) studied the samples (27) belonging to nine commonly used vegetables i.e. turnip, spinach, cauliflower, squash, squash melon, arum, tomato, cabbage and cucumber purchased from local markets of Nawabshah district, Sindh were transported in ice box to Ecotoxicological Research laboratories of National

Agricultural Research Center, Islamabad. Ppesticide residues were monitored in vegetable samples for dichlorvos, fenvalerate, dimethoate, methyl parathion, fenitrothion, cypermethrin, endosulfan, deltamethrin, mevinphos, chlorpyriphos, profenofos and dicofol pesticides. All the samples were found contaminated with pesticides and among these five out of nine samples were found exceeding the Mmaximum Rresidue Limits (MRL).

Some studies, although of academic in nature, had revealed the presence of pesticide residues in vegetables of Faisalabad. For instance residues of endosulfan in 10 (100%) gourd samples (Talib, 1991), DDVP in 9 (100%) bitter gourd samples (Bashir, 1990), malathion in 13 (43%) gourd (Khan, 1987) and 11 (37%) radish samples (Saeed, 1986), endrin in 35% of cucumber and 42% of okra (Ilahi, 1985), 5 (37%) peas (Maqbool, 1985), 16 (37%) cucumber (Amin, 1984), 20 (40%) cooked okra (Shireen, 1984), 20 (40%) okra (Khan, 1984), 01 (10%) radish and 03 (30%) cabbage samples (Sheikh, 1982) have been reported. However, no BHC residues were detected in any spinach samples (24) (Kausar, 1983).

Role and need of a regulatory body: The Ministry of National Food Security and Research previously known as Ministry of Food, Agriculture and livestock (MINFAL) has the controls pesticide regulation in the country, while the Department of Plant Protection in Karachi is responsible for registration and other regulatory aspects of pesticides. To legalize the use of pesticides in the country Agricultural Pesticide Ordinance was promulgated in January 1971 and Agriculture Pesticide rules were framed in 1973. This law regulates import, manufacture, formulation, machinary, distribution and use of pesticides in the country. Besides this, Agricultural Pesticide Technical Advisory Committee (APTAC) was also established to advise the central Government under the 1971 Pesticide Ordinance, when pesticide business was shifted form Public to Private sector. The ordinance was further amended in September 1992 to allow pesticide import under generic names rather brand names and then it was amended in December 1997 to strengthen the punishment provision for pesticide adulteration. There is no rule existing in Pakistan regarding the safe residual limit for application of different pesticides to various crops, vegetables and fruits. Pesticides and other contaminants of food products are regulated through some concept like Maximum Residue Limits (MRLs) which is the maximum concentration of pesticide residue resulting from the use of pesticides according to Good Agricultural Practices (GAP). It is the limit that is legally permitted to recognize as acceptable in or on food, agricultural commodities and is expressed in milligrams of pesticide residue per kilogram of the commodity. A pesticide can be registered in Pakistan even without field testing (Form-I) if already registered in the country of origin due to soft policy of import and registration of generic product. Legislation and regulation, however is only as good as its enforcement which is the major constrain in most of the developing countries like Pakistan. Pesticides and other chemicals increased the agricultural production in general but persistent residues of these chemicals have tremendous harmful impact on the environment whereas, the abundance of adulterated or fake pesticides in the market and illiterate farmers further aggravate the situation. All these combined pose a serious threat to our environment and also to human health.

A number of national and provincial institutions are conducting research with regards to monitoring of residues in food, drinking water and the environment, a comprehensive national monitoring system is still missing. A considerable attention needs to be focused on the threat to human life coming from the dietary food, drinking water, and the residential risk caused by the presence of organic micro pollutant. Pesticides are mainly adsorbed and degraded in the top soil, while some pesticides combined with appropriate environmental conditions can involve a risk of leaching and contaminating shallow groundwater and soil. The pesticides are reported to be leach down transported from the soil to ground water by downward percolation of water. Growing public awareness has led to increased concern about the environment and more particularly about water quality. It has been established that no policy can be enforced without measurement and analysis. The initial willingness to comply with regulations is often hindered by the absence of official methodologies, clear directives and lack of specific knowledge of environmental analysis. Monitoring of organic micro pollutant is a key tool for ensuring conformity with regulation. Therefore, a Regulatory Directorate is being proposed to be established under the Ministry of Food, Agriculture and Livestock with the following mandated objectives.

1. To develop a computerized data base system to record the violation of MRLs in the domestic and imported commodities (especially from the neighbor countries using and manufacturing DDT like chemicals) to follow up in case of violation.

2. To provide analytical solutions for the identification and measurement of priority pollutants in various biological and environmental matrices and detailed instructions on sample preparation and clean-up procedures based on the rationalized labor and cost effective a major bottleneck in environmental testing laboratories.

3. To launch inter-calibration scheme among the national laboratories participating in the monitoring program for the validation of analytical methods.

4. To compile data on parameters like ADI, terminal residues and diet patterns, loss of residues during storage, drying cooking and washing of pesticides in food commodities. The terminal residues of a

particular pesticide on a treated crop would be calculated by conducting supervised trials under Good Agricultural Practice (GAP) with collaboration of other institutions in Pakistan.

5. To conduct nutritional surveys to compile data of regional diet patterns and quantum to estimate the Average Daily Intake (ADI), this is expressed in terms of mg/kg body weight, for risk assessment.

6. To establish control measures in order to ensure MRLs to be respected to avoid toxic substances in the pesticides treated food by regulating the minimum of time must elapse between the last spraying of the crop and its harvest especially for fruits and vegetables prevent adverse effects on public health. This is useful for assessing human exposure to pesticides through the food supply and for understanding the magnitude of health risk.

7. To develop a computerized data base system on agricultural pollutant in our food, environment and biosphere at large for creating awareness of the trends of level of contamination at the normal level for the assessment of research.

8. To legalize the monitoring of pesticide in Pakistan to face the implication of WTO and to control the indiscriminate use of the pesticides in the country and to develop strategies for enforcement measure to ensure that the residue remain with prescribed safety limits and consumers are not exposed to any risk by eating food containing any chemical residues.

9. To frame the rules and regulation to restrict the use of chemicals on vegetable and fruits which are registered for cotton only and to control the reporting limits of the pesticide residues above the MRL e.g. 50% above MRL would be allowed to report to avoid unnecessary panic among non-scientific community and general public.

10. To generate data on metabolites (some time more toxic), fate in the environment besides acute and chronic toxicities to screen the Xenobiotic for No-Observed-Adverse-Effect–Level (NOAEL) calculated ADI through different animal models with the coordination of academic institution.

11. To develop the strategies especially for agricultural commodities from the farm gates or from the whole sale markets e.g. “Tag Tracking System” with the collaboration of Agricultural Extension Departments to determine correctly the extent of harm through excessive pesticide residues to punish those who are guilty on neglecting in this regard.

12. To develop coordination among the participating laboratories in all provinces of Pakistan through technical assistance, Identification of their training need and making recommendation for their up gradation.

13. To provide a regular platform to exchange ideas and experience by arranging regular meetings, seminars and workshops in cooperation with the private sector and academic institution that would provide a bridge between private and public sectors institutions.

14. To frame rules to involve the Pesticide companies to invest in research and development activities related to agricultural chemicals and 1-2 % of their budget must be allocated to establish and strengthen proposed regulatory body.

In Pakistan rules are not in existence for MAC and MRL as set by EEC therefore, it is proposed that regular monitoring of cops, vegetables, fruits and drinking water for pesticide residues should be made and it should be vouched that MRL and MAC in every case be respected. A Regulatory Directorate under Ministry of Food, Agriculture and Livestock must be established for which strict rules should be framed and followed.

CONCLUSION

Pesticides are an integral part of the modern agricultural protection and becoming lethal to the environment at micro level of concentration. It has been established that they are highly mobile and contaminated soil, surface water and as well as ground water in Pakistan. A number of national and provincial institutes are involved in plant protection research. But none of these institutes offer regular training courses in field of pesticides analysis. National Monitoring System is still missing for monitoring the residues in food, water and the environment. Considerable attention needs to be focused on the threat to human life coming from the food and drinking water and the residential risk caused by presence of organic micro pollutant. It has been established that no policy can be enforced without measurement and analysis. The initial willingness to comply with regulations is often hindered by the absence of official methodologies, clear directive and shortage of trained manpower. Monitoring of organic micro-pollutant is key tool for ensuring conformity with regulation

and it needs sophisticated chromatographic instruments. In Pakistan rules are not in existence for Maximum Acceptable Concentrate (MAC) and Maximum residual Level (MRL) set by the international agencies. Therefore, a preliminary five years research proposal is being developed for strengthening the existing facilities of PRI with the mandated objectives to vouch that MRL and MAC in crops, vegetables, fruits and water and to create awareness among occupational and non occupational groups by developing the computerized data base system and trained manpower in the field of pesticides analysis to cope the problems of pesticide residues in the food commodities and in the environment to manage the risk associated with hazardous chemicals and this should be a continuous process with reliable equipments and trained manpower with continuous monitoring our agricultural and food commodities would earn confidence even in western, developed WTO abiding countries.

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