Enhancing Competitiveness in Agriculture to meet the challenges of WTO and other PTAs

Agriculture (WTO Cell) Department
Government of Kerala

Enhancing Competitiveness of Agriculture to meet the challenges of WTO and other PTAs

Proceedings of the Seminars held at

SAMETI, Anayara
25 & 26 November 2011

and

College of Horticulture, Vellanikkara
24 & 26 January 2012

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Foreword

The formation of the World Trade Organisation in 1995 transformed the entire world into a single global market, with the intention of an expansion in market access and trade ultimately leading to the growth of the developing and the least developed nations. This implies that the resource poor small and marginal farmer (whose holding size is as small as 0.11 ha in Kerala) has to compete with the technically much advanced large farmers of the developed countries. Unless made competitive, our farmers will find it difficult to survive in the new era. Competition in the post globalization period doesn't stop at production and productivity enhancement. Quality standards, Sanitary and Phyto Sanitary Standards (SPSS), Good Agricultural Practices (GAP) are all gaining significance in global trade. The stress has to be both on productivity enhancement as well as on market competitiveness. It is hence imperative that the extension functionaries and researchers of the State are sufficiently capacitated in the new rules and standards set by the WTO as well as the implications of the several Free Trade Agreements in which India forms a party. The laws governing international trade are complex and the extension agents and officials have to function as stepdown Transformers to present them in a simple and logical form to the farmers and equip them to fare competitively in the new regime.

The efforts taken by the WTO Cell in planning and conducting the Seminar in two phases - one at Thiruvanathapuram and another at Thrissur may be seen in this perspective. Bringing out the proceedings of the two Seminars as a combined volume will serve as good reference material for all those interested.

29.2.12

(K Jayakumar)

Government Secretariat
Thiruvananthapuram
29- 2-2012.

Contents

Seminar on "Enhancing Competitiveness of Agriculture to meet the challenges of WTO and other PTAs"

Background

India was a signatory to the GATT (General Agreement on Tariffs and Trade) which was the precursor to the present World Trade Organisation. The WTO came into existence on January 1, 1995 following the Uruguay Round and the Marrakesh Agreement with the main function to ensure that "trade flows as smoothly, predictably and freely as possible." The developing and the Least Developed Countries joined the WTO with the hope that they will gain access to the developed markets of the world which in turn will pave way for their development. However there was much discontent later as was evidenced by the large scale and sometimes even violent protests staged by activists at the venue of successive ministerial at Cancun and Seattle. But the fact remains that WTO and globalization have come to stay and the developing and least developed countries have to learn to live competitively in this new regime.

With the failure of the Doha Development Agenda, India started the Look east Policy and began entering into several regional and preferential trade agreements among which the biggest is the India ASEAN FTA. More and more FTAs (Free Trade Agreements), CEPAs (Comprehensive Economic Partnership Agreements) and CECAs (Comprehensive Economic Cooperation Agreements) are being negotiated and finalized by the Central Government and these are likely to have favourable as well as negative impacts on the State economy in general and agriculture in particular.

The agricultural sector of Kerala is dominated by small holders who own and operate on an average less than 0.4 ha of land. Smallness of the operational holding often sets constraints to effecting improvements in farm technology as well as in availing infrastructure and other support from government and non government agencies. Major share of the export earnings to Kerala agriculture comes from the spices sector which is also dominated by small farmers. Though majority of the agricultural commodities are now getting better prices mainly due to supply side constraints, the situation may not prevail for long. In the post liberalization period

farmers are also under threat of global competition. India ASEAN FTA has particularly adverse implications for the spice and plantation sector of Kerala. Though the principle of "micro pains for macro gains" offer little solace to us, it is also true that we cannot escape the effects of the Agreements entered into by the Central Government. In this context, it is highly imperative to identify the major constraints which our farmers face and to chalk out ways and means to improve the competitiveness of our agriculture sector so that our farmers will be able to better cope with the new market regime of the post WTO era.

There is also a paradigm shift from production led extension to market led extension, where the focus is on maximizing net returns to the farmer through efficient market interventions. Provision of warehouse and cold storage facilities, credit support against warehouse receipts, provision of minimum support price, government procurement at MSP and provision of timely, accurate market information and intelligence can benefit the farmers immensely.

In this context it was felt necessary that the scientists and extension functionaries of the State should be kept abreast of the developments in international trade agreements so that necessary changes in research and extension strategies can be planned and implemented. Hence this Seminar was organized in two phases – one in November, 2011 at Thiruvananthapuram for the Officers of the Southern districts (up to Idukki) and another at Thrissur for the Officers of the Northern districts. Officers from the Departments of Agriculture, Animal Husbandry, Soil Survey, Soil Conservation and Scientists from the Kerala Agricultural University attended the programme. The programme could cover only a very minor part of the large pool of extension functionaries and hence may be extended to other parts of the State in the next financial year.

The lectures were arranged in two major focus areas. One has direct relevance to WTO like Impact of FTAs and PTAs on trade, SPSS, TRIPS, Market intelligence etc and the other has relevance to the field problems hindering competitiveness like soil and nutrient related constraints and managing pests and diseases with an eye on the global market.

The first seminar on "**Enhancing Competitiveness of Agriculture to meet the challenges of WTO and other PTAs"** jointly sponsored by the Agri(WTO Cell) Department, Government of Kerala and Agricultural Market Intelligence Centre, Kerala Agricultural University was conducted at SAMETI, Venpalavattom, Anayara on 25th and 26th of November, 2011.

The Seminar was inaugurated by the ACS & APC, Sri K Jayakumar, IAS at 10 AM on 25th November, 2011. The inaugural session was chaired by Dr P C Raveendranath, Director, SAMETI and felicitated by Dr K Satheesh Babu, Professor (Ag Econ) & Principal Investigator, AMIC, KAU. Dr S Regeena, Special Officer, WTO Cell gave the welcome

address and Dr N G Balachandranath, Deputy Director, SAMETI, proposed the vote of thanks. Fifty officers from the Departments of Agriculture, Dairy Development, Soil Survey, Soil Conservation and the Kerala Agricultural University attended the Seminar.

In his inaugural address the APC stressed the importance of providing advance and reliable information on changing socio-economic environment and climate and price related matters to the farmer so that he can make an informed decision on the crops to grow and when and how to market his produce. He opined that many farmer suicides could have been avoided, if correct information was available to the farmers. He further emphasized the need to assess the WTO agreements as well as the FTAs, take both positive and negative effects and forewarn the farmers on the negative aspects. These agreements, he said are complex and so technical experts should act as step down transformers to explain them in a simple manner to them. They should also be provided with handholding support to enhance productivity and also to conform to the changing product requirements of a global market, where quality standards are going to be more and more stringent.

The technical sessions started at 10.30 AM. The seminar ended on a very positive note and the main constraint felt was a lack of time to cover all aspects related to the changing market scenario in the post globalization period.

Details of the sessions are given below.

Date & Time	Topic	Resource Person
Day One 25-11-2011		
10.30 to 12.30 PM	Proliferation of FTAs and their impact on Kerala Agriculture	Dr K N Harilal Associate Professor, CDS
12.30 - 1.30 PM	GATT, WTO and the present status of trade rounds	Dr S Regeena, Special Officer, WTO Cell
1.30 to 2 PM	Lunch break	
2 -5 PM	Market Intelligence - Relevance, current status and ways forward	Dr K Jessy Thomas and Dr K Satheesh Babu, Agrl Market Intelligence Cell, Dept of Ag Economics, KAU, Thrissur
Day Two 26-11-2011		
10 30-1 PM	Addressing the Issues in the Plantation Sector of Kerala	Dr K J Joseph, Professor, CDS, Thiruvananthapuram
2- 4 PM	Managing Pests and diseases in the post endosulfan period - WTO Concerns	Dr Thomas Biju Mathew Professor (Entomology), College of Agriculture, Vellayani - 2-3 PM Dr P J Joseph, Professor (Pl Path), College of Agriculture, Vellayani - 3-4 PM
4- 4.30 PM	Intellectual Property Rights - An introduction	Sri B Harikumar Agri Officer, Eraviperoor Pathanamthitta
4-5 PM	Evaluation Valedictory	Dr S Regeena, Special Officer, WTO Cell

Seminar 2: Considering the positive response obtained from the Officials, the programme was extended to the Northern districts with another seminar arranged at College of Horticulture , Vellanikkara, KAU in association with the Department of Agricultural Economics.

The Seminar held on 24th and 25th of January, 2012 was inaugurated by Dr K R Viswambharan, Hon'ble Vice Chancellor, KAU. The inaugural session was chaired by Dr C T Abraham, Associate Dean, College of Horticulture, Vellanikkara and felicitated by Dr A Augustine, Associate Director of Research, KAU. Dr S Regeena, Special Officer, WTO cell welcomed the gathering and Dr K Jessy Thomas, Professor & Head,

Department of Agricultural Economics, KAU proposed the vote of thanks. Forty officers from the Departments of Agriculture, Animal Husbandry, Soil Survey, Soil Conservation and scientists from KAU attended the programme.

In his inaugural address the Hon'ble Vice Chancellor discussed the plight of the ginger cultivators who are unable even to recoup the cultivation charges from the sales proceeds. He urged the scientists and officers to work hard to assist the farmers in producing more as well as in getting a remunerative price for the produce. He said that as elite members of the society it was our duty to help our small and marginal farmers compete with the farmers of the developed nations like USA, Japan and Australia. Proper guidance in crop selection, cultivation practices, credit needs assessment, provision of infrastructure, insurance support, bargaining for better price etc must be possible. He suggested that the WTO Cell may transform into a "Solace cell" to the deprived farmers of the State.

The details of technical sessions and the detailed presentations are given in the ensuing pages.

This programme was also well received, but the Officers of the Department of Agriculture raised several concerns regarding their pattern of work which hindered them from addressing the real issues in the field, including those raised by the WTO and FTAs. They opined that most of the problems in the agriculture sector emerge from a lack of effective contact and interaction between the farmer and the extension functionary. Unless the officer can function as a Specialist Officer to address the field level problems, his effectiveness in making agriculture competitive will remain, at the most marginal.

Date & Time	Topic	Resource Person
Day 1 **24.1.2012**		
10 AM- 10.30AM	Inauguration	Dr K R Viswambharan Hon'ble Vice Chancellor, KAU
10.30 to 11. AM	Introducing the topic	Dr S Regeena Special Officer, Agri(WTO cell)
11.15 -1. 15 PM	PTAs and CECAs and their impact on Kerala Agriculture	Dr K P Mani Professor & Head Department of Economics John Mathai Centre, Thrissur.
1.15 to 2 PM	Lunch	
2-3.30 PM	TRIPS and their significance in Agriculture	Dr C R Elsy Professor & Coordinator, IPR Cell Kerala Agricultural University
3.30 to 5 PM	Management of pests and diseases with an emphasis on global trade	Dr Jim Thomas Professor & Head Communication Centre Kerala Agricultural University
Day 2 **25-1-2012**		
10-11.30 AM	Sanitary and Phytosanitary measures with special reference to trade in Agriculture	Dr Jose Joseph Professor (Ag Extension) College of Agriculture Padannakkad
11.45 to 1.15 PM	Management of soil and nutrient related constraints to farming	Dr P S John, Professor & Head, Dept of Agronomy, College of Horticulture, Vellanikkara
1.15 to 2 PM	Lunch break	
2-3.30 PM	Relevance of Market Intelligence in agriculture in the post WTO era	Dr Satheesh Babu Professor & PI AMIC, Kerala Agricultural University
3.30 to 5 PM	Evaluation and Feed back from participants.	Dr S Regeena Dr K Jessy Thomas Professor & Head Dept. of Agrl Economics CoH, Vellanikkara

GATT, WTO, FTAs - A Timeline

Dr S Regeena
Special Officer, Agri(WTO Cell) Department

The World Trade Organization (WTO) which came into being in 1995, deals with the global rules of trade between nations. Its main function is to ensure that trade flows as smoothly, predictably and freely as possible.

GATT (General Agreement on Tariffs and Trade), the precursor to WTO was formed in 1948 in GENEVA with 23 members. It was intended to create a third institution to handle the trade side of international economic cooperation, after the World Bank and the International Monetary Fund. The GATT seriously negotiated the formation of ITO (International Trade Organisation) and the draft charter was formed and it was aimed to create the ITO at a UN conference on Trade and Employment in Havana, Cuba in 1947. However, in 1950 the ITO was dropped mainly due to opposition from US Congress, even though US was a member of the GATT. GATT hence continued as the only multilateral agency governing international trade until the WTO was formed in1995.

The GATT progressed in several rounds of discussions, the timeline of which is given below.

Year	Place	No of member countries	Topic of discusion
1949	France-Annecy	23	tariffs
1951	Torquay, England	38	tariffs
1956	Geneva	26	tariffs
1960-61	Geneva Dillon Round	26	tariffs
1964-67	Geneva – Kennedy Round	62	tariffs & anti dumping
1973-79	Geneva – Tokyo round	102	Tariffs, non tariff measures, framework agreements - tariff in 9 major industrial countries reduced to an average of 4.7 %
1986-94	Geneva – Uruguay round	123	tariffs, non tarifs, rules, services, intellectual property, dispute settlement, textiles, agriculture, creation of WTO

Was GATT a Success?

GATT increased trade to the tune of 8 per cent per annum and number of members increased from 23 to 123, indicators of success. However, efforts at liberalizing agricultural trade met with little success. Plagued by high rates of unemployment in Western Europe and North America, governments sought bilateral market-sharing arrangements with competitors and embarked on a subsidies race to maintain their holds on agricultural trade. Even GATT's institutional structure and its dispute settlement system caused concern.

Hence a new system was needed and discussions on the creation of WTO was initiated in the Uruguay round (1986-94), which culminated in the Marrakesh Declaration and on 1-1-1995 WTO came into being. According to the WTO website, the World Trade Organization (WTO) deals with the global rules of trade between nations. Its main function is to ensure that trade flows as smoothly, predictably and freely as possible.

Progress of WTO Trade Negotiations

The topmost decision making body of the WTO is the Ministerial Conference. So far 8 Ministerial Conferences as given below have been held from 1996 to 2011 of which the Doha round or the Doha Development Agenda as it came to be known is the most discussed one.

1. Singapore – 9-13, Dec 1996.
2. Geneva – 18-20 May 1998
3. Seattle – Nov 30 to Dec 3, 1999
4. Doha – 9-14 Nov 2001
5. Cancun – 10-14 Sep 2003
6. Hongkong – 13-18 Dec 2005
7. Geneva – Nov 30 – Dec 2, 2009
8. Geneva – 15-17 Dec 2011.

Doha Round (2001- .....) or the Doha Development Agenda

When the Doha Round was launched, ministers placed development at its centre. "We seek to place developing countries' needs and interests at the heart of the work Programme adopted in this Declaration," they said. "... We shall continue to make positive efforts designed to ensure that developing countries, and especially the least-developed among them, secure a share in the growth of world trade

commensurate with the needs of their economic development. In this context, enhanced market access, balanced rules, and well targeted, sustainably financed technical assistance and capacity-building programmes have important roles to play."

However, things didn't progress as planned and negotiations faltered at different points. While in 2008 main difference was over farm tariff levels, in 2011 – difference is on industrial tariff cuts.

US demanded the complete elimination of tariffs of emerging economies like India, China and Brazil in sectors such as chemicals, industrial machinery and electric and electronic products to which the BRIC nations are not willing to concede.

Pascal Lamy, Director General of WTO proposed an "early harvest" package that could be agreed upon by a ministerial meeting in December. This includes immediate resolution to the problem of the US's trade distorting cotton subsidies*, duty-free quota-free trade access to the rich world's markets for exports from the least developed countries, a waiver to accelerate services exports from poor countries and easing of the accession requirements** for LDCs wishing to join the WTO.

What was once the main bulk of the agreement – liberalisation of trade in industrial and agricultural goods and services – will be left for later. India also agreed to the early harvest package.

India as a founder member of the erstwhile GATT and also the WTO in 1995 firmly believed in multilateral trade for common benefit. However with the Doha Development Round floundering India started entering into Free Trade Agreements, Preferential Trade Agreements and Comprehensive Economic Cooperation Agreements with several of her trading partners.

LOOK EAST POLICY

India began economic and strategic ties with countries of SE Asia as a part of the Look East policy. Signing of FTA with 10 member ASEAN countries on 13th August 2009, came into effect from 1st January 2010. IAFTA is the biggest Preferential

* Benin, Burkina Faso, Chad and Mali are 4 major cotton producing countries of the World. The subsidies given by US and EU to their cotton farmers keep the prices low and put these countries to very great difficulty.

** Getting a WTO membership is not easy. Article XII of the WTO Agreement states that accession to the WTO will be "on terms to be agreed" between the acceding government and the WTO. Accession to the WTO is essentially a process of negotiation — quite different from the process of accession to other international entities, like the IMF, which is largely an automatic process. It may take as long or more than 15 years for the accession process to be completed.

Trade Agreement in Free India. It is a TIGA – Trade In Goods Agreement – and aims at a full fledged Free Trade Area between ASEAN and India

TIGA focus on tariff liberalisation on mutually agreed tariff lines from both sides and targets to eliminate tariff on 80 per cent of tariff lines & 75 per cent of trade in a gradual manner from January, 1, 2010.

ASEAN is India's 4th largest trading partner after EU, US and China and accounts for around 10 per cent of our global trade. It is hoped that our exporters and manufacturers will be benefited by the TIGA.

Tariff Reduction Details

There are four broad categories of Tariff lines designated as Normal Track I, Normal Track II, Exclusion List and Sensitive Track.

Normal Track -1 (NT-1): Applied MFN* tariff rates will be reduced from 1st January 2010 and eliminated by 31 Dec 2013.

Sensitive Track (ST): As much as 500 products are included under this group. Applied MFN tariff rates are to be reduced to 5 per cent by 2016 for 50 lines. Remaining rates to be reduced to 4.5 per cent in 2010 and to 4 per cent by 2016. On 4 per cent tariff rates will be eliminated by Dec 2019.

Highly Sensitive Lists (HSL): Three categories come under this list.

1. Reduce AMFN rates to 50%
2. Reduce AMFN rates by 50 %
3. Reduce AMFN rates by 25%

India has no tariff lines under this category.

Exclusion List (EL): No commitment for tariff reduction. Base rate, AMFN rates as on 1st July 2007 can be retained. However they will be subject to an annual tariff review with a view to improve market access.

Special Products (SP): Crude and Refined Palm Oil, Coffee, Black tea and Pepper come under this category. They are subject to separate tariff reduction schedule.

*MFN – No discrimination

Tariff Reduction Schedule (SP)

Tariff line	Base rate	As on 2010	By Dec 31, 2019
Crude Palm Oil	80	70	37.5
Refined Palm Oil	90	86	45
Coffee	100	95	45
Black tea	100	95	45
Pepper	70	68	50

All members of the World Trade Organization (WTO) receive the Most Favored Nation Status. This means they all receive the same trade benefits as all other members. This is critically important for smaller members, because it lowers the cost of their exports and makes them more competitive. This, in turn, increases their exports and their country's economic growth. Some exceptions are allowed. For example, countries can set up a free trade agreement that applies only to goods traded within the group — discriminating against goods from outside.

Base rates are applied rates as of 1st July 2007 and not bound rates as in WTO agreements. When there is considerable difference between applied rates and bound rates, as in India, this can be harmful.

Applied rates will be lowered immediately and will become the bound rates for IAFTA. Outside IAFTA, WTO bound rates can apply. But for products for which IAFTA is the major supplier this is irrelevant.

Bound rate is the maximum rate of tariff allowed by the WTO to any member state for imports from another member state. Once bound, it may not be raised without compensating the affected parties.

Applied rates are duties that are actually charged on imports. These can be below the bound rates.

Proportion of tariff lines in different categories

Country	EL	NT-1	NT-2	ST	HSL
Malaysia	9.9	59.2	14.6	15.1	1.2
Myanmar	14.1	64.4	7.5	14	0
Philippines	13	58.9	17	6.8	4.4
Vietnam	18.3	60.3	8.9	7	5.6
Thailand	12.2	67	8.9	11.7	0.2

IAFTA impact

Production relationships among countries can be

1. Complementary- benefits of FTAs are going to be more
2. Competitive – countries having no comparative advantage will be losers

South Indian States especially Kerala have similar agro-climatic conditions with many ASEAN Nations. Hence similar production pattern in agri and related sectors – especially fisheries. Natural rubber, tea, coffee, coconut, spices, cashew and tropical fishes like shrimp, crustaceans, tuna, cutla- main specialties of Kerala in the international markets are being produced and exported by ASEAN countries.

Major exporters - Natural Rubber

Country	Qnty ('000 t)	Value (lakh $)	Unit value ($/t)
Thailand	836	13876	1659
Belgium	31	1407	4481
Malaysia	45	1303	2922
Netherlands	23	1043	4605
Gautemala	20	602	2957
India	13	361	2754

Major exporters - Tea

country	Quantity ('000 tones)	Value (lakh $)	Unit value ($/t)
Sri Lanka	318	12587	3954
Kenya	397	9349	2357
China	280	7006	2337
India	203	592	2905
UK	27	3247	11742
Germany	27	2072	7677

Products of significance to Kerala

Crude and Refined palm oil (HS code: 151110,151190)

Not decaffeinated coffee (HS Code:901111)

Black tea (HScode: 90240)

Pepper (neither crushed nor ground)

A Free Trade Agreement (FTA) has two effects

1. Trade creation – increased import from partner countries to meet increased domestic demand due to fall in price (due to reduction in tariff)
2. Trade diversion – accounts for tendency of importers to substitute goods from one source to another in response to a change in import price

Simulation analysis using SMART Model (Ex ante partial equilibrium model) gives the following results.

Scenario 1 -2015

Palm Oil: Import of 200 crore US $ worth of palm oil into India.

Benefit to Cambodia, Indonesia, Malaysia and Thailand

Adverse effect to China, Morocco and Sri Lanka

Highest import will be from from ASEAN.

Coffee - Increase in import of 263 per cent by 2015 and 493 per cent by 2019

Pepper - No significant increase in imports of pepper

Tea - Trade diversion for Argentina (130.2), China (129), Kenya (560), Nepal(331)

Max benefits to Vietnam (2033.6 thousand US $)

Increase in imports can exert a downward push on the domestic prices due to actual and potential threat of imports and will adversely affect income of farmers.

Exclusion List: It is claimed that majority of the commodities is under Exclusion List and as such is outside the purview of tariff reduction under the IAFTA. However the truth is:

Only 3.2 per cent has tariff protection over 100 per cent, 44 per cent tariff rates are less than 10 per cent, fish and fish products carry only 30 per cent and as such threat of imports is high.

Our Concerns

Higher imports can lead to lower prices which in turn can lead to farmer distress.

Only India has 0.3 per cent products under Special products and those products happen to be very crucial to Kerala. – why?

Why not in exclusion list?

IAFTA is envisaged to be a CECA wherein the services sector will be opened up and India hopes to attain huge gains out of this. Hence these are "Micro pains for macro gains."

How do we cope with the challenges?

Options :

Productivity enhancement?

Replanting and rejuvenation of old and senile plants?

Subsidies ?

Infrastructure support ?

Integrated farming ?

Better marketing facilities ?

Productivity ratios in ASEAN countries

Country	Coffee	Tea	Pepper
Indonesia	0.91	0.83	2.42
Malaysia	0.75	1.18	6.48
Thailand	1.06	0.18	10.13
Vietnam	2.60	0.80	7.01
World	1.11	0.99	2.79

There is immense scope for productivity enhancement as can be seen from the huge gaps that exist between our levels and the productivity levels of other producing countries. But how do the small farms compete effectively with large farmers of the USA and EU and still remain internationally competitive. If we have to reap the benefits of scale associated with large farms of the developed countries, the only way is to form commodity or farmer interest groups and operate for the common benefit of all.

However this needs strong policy measures to provide infrastructure support, massive replanting and rejuvenation programmes on a war footing as well as strengthening of the marketing infrastructure.

The post WTO era has brought down tariff barriers, but several non tariff barriers in the form of Sanitary and Phyto Sanitary Standards, packaging and labeling requirements and even private standards are coming into force in International trade. Hence simply enhancing productivity will not serve the purpose; productivity with quality is of utmost significance. This aspect also merits consideration.

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Improving Marketing Efficiency: The Role of Market Intelligence

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Introduction

The agricultural market environment is changing with unprecedented speed and in very diverse ways - locally and globally. These dynamics affect farm prices and thereby farm income. The majority of the rural producers are unable to understand and interpret the market and price behaviour into their advantages (Ajjan et al, 2009). The study of temporal and spatial variations in the price of agricultural commodities provides a better insight to handle price fluctuations. This will benefit the producers, traders and the consumers alike. With the transformation of agriculture from subsistence to commercial production systems, farmers also needed more market orientation to succeed in business because commercial production is basically market oriented. Only market orientation and market responsiveness could fetch better prices under the changed situation. Thus, it is not enough to produce a commodity; it must also be marketed well.

Market Information and Intelligence: A Vital Missing Link

Lack of marketing information has been a major bottleneck in agricultural marketing in India in general, and in Kerala in particular. Marketing information is vital for taking correct production and marketing decisions, especially for market oriented cash crops grown widely in the State. Unequal accesses to market related information and intelligence inputs lead to unequal playing grounds for farmers and traders. The farmers' ignorance was the trader's gain till now (Anjaly et al, 2010). Though farm related information has been provided by the radio, TV and newspapers, there was no mechanism to analyze, interpret and convert this vast volume of information into simple, comprehensible trade intelligence. This calls for a farmer friendly, easily accessible, reliable and regional market intelligence systems.

Market Information vs Intelligence

Market Intelligence is a process of giving insights into what might happen in the near future. This process requires that we gather data, analyze it appropriately into information, and transform it into easily comprehensible intelligence inputs decipherable even by a common man, devoid of sound technical background or sophistication. Intelligence differs from data and information since it requires some form of analysis. This way, pile of data and information are filtered and refined so that an end user is provided with decision making options, giving them an opportunity to make forward-looking decisions.

Market Intelligence should not simply present the facts, declaring what we found; but instead make a statement, saying this is what we believe is about to happen. In this manner, market intelligence allows a user to remain competitive by improving strategic options. Many equate market intelligence with other disciplines, such as information management. Although market intelligence draws heavily from other disciplines like economic theory, econometrics, statistics, computer applications, market information systems, and management, smart intelligence tends to be very analytical, very intense, and very savvy in its content and approach by integrating all useful aspects of these disciplines for the sake of its potential users.

Market information and intelligence are crucial to enable farmers to make informed decisions about what to grow, when to harvest, and when to sell the output. Undoubtedly, the most important marketing intelligence need of the farmer is price intelligence. Agricultural price data are based on thousands or millions of transactions, many of them on a small scale, that are taking place every day all over the country. Collecting an adequate sample and making sure that these are representative enough to be useful is not an easy task. As farmers become more market oriented, extension workers need to be in a position to advise them not only on how to grow crops but also on how and when to market them.

Agricultural Market Intelligence: A Historical Perspective

It is said that wherever there is a market, an information network also co-exists. New market trends, consumer preferences, new suppliers or new markets can alter the nature and pattern of transaction. A single farmer while giving his entire time of planning production related activities single handed cannot keep track of the changing market or price signals. The relevance and need of institutional mechanisms to advise the farmer on such trade related aspects assume. Market intelligence is thus a critical component towards the efficient functioning of agricultural markets by providing timely information about the market conditions and helping to realize remunerative prices.

Even though agricultural market intelligence systems have been a pillar of support to farmers in agriculturally developed countries like the USA, Canada or

Australia, it is still in its infancy in developing countries like India. Despite tall claims by many agencies, pioneering works in true agricultural market intelligence systems were started by the Tamil Nadu Agricultural University, Coimbatore from 2004 onwards . The Domestic and Export Market Intelligence Cell (DEMIC) is credited forecasting of prices of major agricultural commodities like Rice, Maize, Bengal Gram, Black Gram, Red Gram, Cotton, Red Chillies, Turmeric, Groundnut, Sesame, Sunflower, Onion, Potato, Tomato, Cardamom, Pepper, Coconut, Brinjal, and Coriander throughout the year on a continued basis, with a forecasting accuracy at 90 to 96 per cent probability levels. The success of DEMIC in providing timely and reliable agricultural market intelligence to the farmers in Tamil Nadu with impeccable forecast accuracy led to the national launching of the National Agricultural Innovation Project (NAIP) on "Establishing and Networking of Agricultural Market Intelligence Centres in India" by the Indian Council of Agricultural Research (ICAR) under component I . The project was officially launched on 27 June 2009 at TNAU, Coimbatore at a colourful function by the then National Director of NAIP, Dr. Mruthyunjaya.

The project operates on a consortium mode, with Tamil Nadu Agricultural University, Coimbatore as the Consortium Leader. It includes Kerala Agricultural University, Vellanikkara, UAS, Banagalore, UAS, Dharward, Acharya N.G.Ranga Agricultural University, Hyderabad, Dr.Punjab Rao Deshmukh Krishi Vidyapeeth, Akola, Gujarat Agricultural University, Junagadh, GB Pant University of Agriculture & Technology, Pant Nagar, Maharana Pratap University of Agriculture and Technology, Udaipur, CCS Haryana Agricultural University, Hissar, and Punjab Agricultural University, Ludhiana as the Cooperating Consortium Partners. The consortium is formed with a twin strategy of covering crops of national prominence and thereby helping the farmers in the major growing states in ensuring higher net price realizations on the one hand, and providing improved regional linkages in the generation, dissemination, and sharing of market information for better decision-making on the other. There is a well defined price forecasting calendar, and the prices of different commodities are forecasted on a regular basis well in advance at the planting and harvest period. The same is transmitted to the farmers through various mass media like news papers, radio, television, mobile phones and through web sites.

As on date, the KAU Centre has released 15 Price Forecasts for Black Pepper (6 Nos.), Cardamom (4 Nos.) and Coconut (5 Nos.), which are the mandate crops for the Centre. The forecasts were given wide publicity through visual media, prominent regional and national news papers and the All India Radio so that it will have maximum farmer out reach. So far, 213 Paper releases, 66 TV telecasts, 27 Radio broadcasts and 36 articles in farm magazines have appeared highlighting the price forecasts and updates from the Centre. Apart from that, 4301 e-mail communication and 18954 hard copy disseminations have been made to various officials of the Department of Agriculture, State Planning Board, Farm Information Bureau, Krishi

Progress and Achievements

Sl.No	Name of the Centre	% Accuracy of Forecasts
1	KAU,Thrisur,Kerala	93-98
2	TNAU,Coimbatore,Tamil Nadu	92-96
3	UAS,Bengaluru, Karnataka	85-90
4	UAS,Dharwad,Karnataka	85-92
5	ANGRAU,Tirupati,Andhra Pradesh	90-94
6	Dr.PDKV,Akola,Maharashtra	89-92
7	JAU,Junagath,Gujarat	85-91
8	MPUAT,Udaipur,Rajasthan	82-90
9	GBPUAT,Pant Nagar,Uttarakhand	85-90
10	CCSHAU,Hissar,Haryana	85-90
11	PAU,Ludhiana,Punjab	80-85

(Source: Domestic and Export Market Intelligence Centre, TNAU, Coimbatore)

Vigyan Kendras (KVKs); and Collaborating Agencies like Spices Board, Coconut Development Board, National Informatics Centre, and major NGOs in Kerala. Voice messages were also sent to 16, 34,000 Green Card Mobile holders by a tie-up through the IFFCO Kisan Sanchar Limited and Bharati Airtel, and 50,000 text messages through Agricultural Technology Information Centre (ATIC) of the University.

The validation of the forecasts of all the Centres were carried out by the Lead Centre during the Post Kharif Workshop held at S.V. College, Tirupati from 21 - 24 September 2010, based on the widely accepted methodology for such forecasts. It is reproduced below. It may be noted that all the Centres are maintaining a reasonably high level of forecast accuracy, and KAU Centre leads the list with a forecast accuracy of 93-98 per cent.

As part of efforts to sensitize the stake holders for capacity building towards the appropriate use of price related intelligence inputs, the Centre has conducted 21 Farmers' Trainings, and 11 Officers' Training as shown below, involving 1291 farmers and 564 Officials from the Department of Agriculture and Scientists from Kerala Agricultural University. Seven Info Series have been released by the Centre involving various aspects of the mandate crops. The outcome at the national level is more formidable because the consortium covers more than 20 crops.

Impact Assessment of Agricultural Market Intelligence

Case 1: Cardamom Price Forecasting in Kerala

Among the Indian states, Kerala has a dominant role as a cardamom producing

area. It accounts for 59 per cent cultivated area and 78 per cent of total production in cardamom. Cardamom prices are subjected to considerable inter year and intra year fluctuations (Fig.1). For instance, the coefficient of variation of prices from January 1995 to July 2010 showed that the price of cardamom was subjected to instability of more than 46 per cent. It was against this background that the NAIP on "Establishing and Networking of Agricultural Market Intelligence Centres in India" under Component 1 attached to the Department of Agricultural Economics, Kerala Agricultural University, Trichur made two price forecasts for cardamom during the production year 2009-10 (both the forecasts are reproduced as Appendix I and II). The first price forecast released on 17-12-2009 highlighted the possibility of cardamom price crossing Rs.1000/ Kg range after Christmas 2009, when the prices were ruling at Rs.650/ Kg, and urged farmers to retain the crop beyond December for better prices. The price of AGEB grade of cardamom was Rs, 999/kg on 24-12-2009. There was no market transaction on 25-12-2009, being the Christmas day. The price of AGEB grade was Rs. 1000/ Kg on 26-12-2009. The price of non graded (bulk) cardamom also crossed Rs.1000 on 03-01-2010.

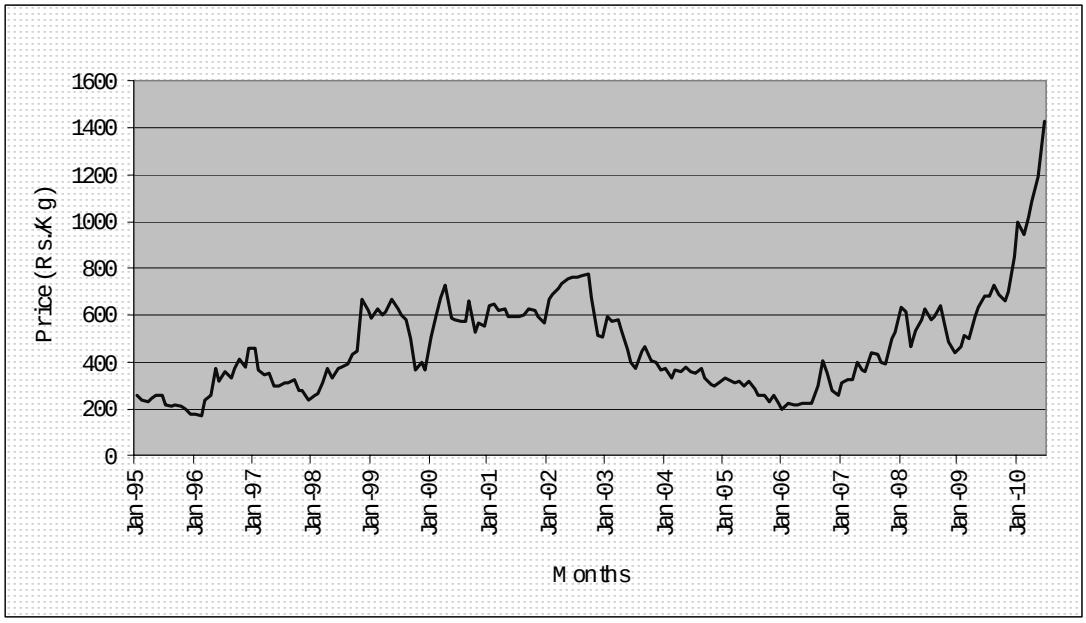

Fig. 1. Trends in Cardamom Prices at Vandanmedu

The cardamom markets in Kerala and the neighboring Tamil Nadu witnessed unprecedented price volatility thereafter. The speculators and the traders started spreading the news that such record breaking prices would not last, and urged producers not to retain their stock. The second forecast released by the Centre on

12-04-2010 clearly indicated that the firming up price is not a temporary phenomenon as apprehended, but cardamom prices would continue to remain volatile till the fag end of the 2009-10 season due to limited supply of cardamom and robust demand. An impact assessment was carried out by the Agricultural Market Intelligence Centre, Kerala Agricultural University in Idukki district, the major cardamom growing tract in Kerala by surveying 30 cardamom growers selected at random. The sample consisted of 8 marginal farmers (<1ha), 11 small farmers (1-2ha) and 11 large farmers (>2ha). The farmers were asked to specify the actual quantity of dried cardamom that was retained and carried over from December to January or subsequent months in anticipation of better prices after coming to know about the possible increase in price after Christmas of 2009. Only this retained quantity is taken into consideration to quantify the impact of the price forecast. The incremental value of this quantity was worked out from the pre December and post December price realizations. The average price realized during the harvest season 2009-10 in the period prior to December was Rs.671 per kg. The average price realized increased to Rs.1093.53 per kg in the post December period, registering an increase by 62.97 per cent. The incremental income realized amounted to Rs.13.19 Lakhs, which on per ha basis worked out to Rs.13,814 (Anjaly et al, 2010). In this case also, the incremental income generated was utilized in real estate purchases, installation of irrigation infrastructure and other permanent improvements on land.

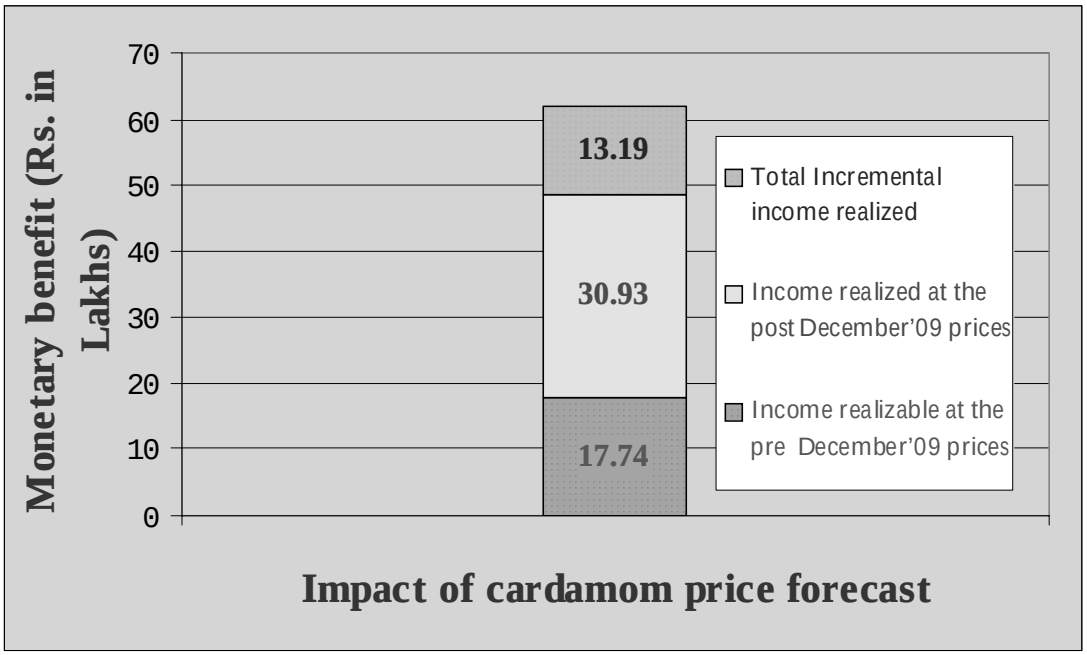

Fig. 2. Impact of Cardamom Price Forecast

Table1. Production and details of retention of the sample farmers

Sl.No	Particulars	Value
1	Average Land Holding Size	3.61 ha
2	Average operated holding under Cardamom	3.18 ha
3	Total Production during 2008-09	85450 Kg
4	Average Price received during 2008-09	
4a.	Prior to December 2008-09	Rs. 443.33
4b.	After December 2008-09	Rs.473.33
5	Total Production during 2009-10	81065 Kg
6	Average Price received during 2009-10	
6a.	Prior to December 2009-10	Rs.671
6b.	After December 2009-10	1093.53
7	Quantity retained beyond December'09	2543 Kg
8	Income realizable at the pre December'09 prices	Rs.1774350
9	Income realized at the post December'09 prices	Rs.3092920
10	Total Incremental income realized (9-8)	Rs.13.19 Lakhs
11	Incremental income realized on per ha basis	Rs.13814.25

Case 2: Turmeric Price Forecasting in Tamil Nadu

The price of turmeric was Rs.2870/ ql in Erode regulated market, one of the biggest markets for turmeric in India during January 2008. It touched the historic high of Rs. 4300/ ql during July 2008. Turmeric farmers were in confusion whether to dispose the produce immediately or to hold the stock to get a better price. The price forecast made by the Domestic and Export market Intelligence Centre (DEMIC) of Tamil Nadu Agricultural University indicated that turmeric prices would rule around Rs.4300 - 4700 /ql during March - April 2009, and it would peak in July 2009. Therefore, turmeric farmers were advised to store turmeric for a few months to reap better prices. Lower production prospects, low carry over stocks and good domestic and export demand were the basis for such optimism. An impact assessment study conducted by Tamil Nadu Agricultural University in 2010 by interviewing 50 turmeric farmers in Dharmapuri district revealed that each farmer on an average, was benefited by Rs.7000 - Rs.9000/ql additionally by the decision to store their produce based on the market intelligence report. The incremental income thus generated was channeled into farm investments like the construction of storage structures (Tamil Nadu Agricultural University, 2010).

Case 3: Cotton Price Forecasting in Andhra Pradesh

India is the worlds' largest producer of cotton and the state of Andhra Pradesh

ranks third in cotton production in India. Cotton prices plunged to Rs.3000- Rs.3200 per Quintal during November and December 2010, due to the traders' lobbying and there were no signs of Cotton Corporation of India entering the market. The traders were quite willing to buy at the prevailing prices. Given this situation, cotton farmers had doubts regarding the disposal of cotton. Against this background Agricultural Market Intelligence Centre (AMIC) of the Department of Agricultural Economics, S. V. Agricultural College, Tirupati in its cotton price forecast advised the farmers to store cotton till the last week of January and February 2011 to realize better prices. In order to capture the impact of price forecast, impact assessment was carried out in Konakanamitla mandal of Prakasam district in Andhra Pradesh by randomly surveying 32 cotton farmers. The quantity of cotton held by the sample farmers as on December 2010 was 670 Qtl. Based on the advice given by AMIC, the farmers stored the cotton beyond January 2011 and February 2011, instead of selling it in December, 2010. This decision to store based on the intelligence input helped the cotton farmers to obtain an incremental income of Rs.21697 per ha when the prices ruled at Rs.4963 and Rs.5500/ Qtl respectively (Bhavanidevi et al, 2010).

Concluding Remarks

The fast changing market environment in agriculture on account of globalization, liberalization and New Economic Policies makes it necessary that the farming community shall be provided with latest market shock absorbing components like market intelligence inputs so as to enable them to reduce the price risk and to handle the new challenges posed by a fast changing market dynamics. Developing commodity specific, regionally linked market intelligence networks assume importance in this context. In India, the agricultural market information were criticized for many shortcomings, the most important being the message not relevant to the needs of the farming community. The NAIP project on "Establishing and Networking of Agricultural Market Intelligence Centres in India" could not only help the farmers in reducing their price risk, but provided many developmental options. As the expectations are great, so are the challenges also.

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Structural Infirmities in India's Plantation Sector

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Administrative Structure

The paper describes the various institutional interventions in the plantation sector starting with the setting up of commodity boards. The administrative set up, composition and functions of various commodity boards and the changes they have undergone over the years are also discussed.

The major problems identified are:

1. Inadequate representation of the various interest groups - Example of rubber board is cited - small holders, traders, block rubber processors do not have any representation. Growers of non -traditional area are also not represented.
2. Duplication of research efforts on the part of SAUs, plantation research institutes.
3. Most commodity boards are bureaucratic in nature

The following recommendations are given to strengthen the system.

1. Ensure adequate representation to all groups (producers, processors, exporters, researchers and policy makers)- considering the vastness of the small holder sector in the plantation economy it is suggested that at least 50 % of members should be from farmers with less than 4 ha area. A greater representation of people with knowledge on the crop may be helpful to transform the Boards into think- tanks enabling it to act as knowledge centers for the farmers.
2. Greater interaction between research institutions, leaving basic research to University system and more collaborative research so as to reap maximum from scarce funds, scientists' time and effort.
3. Greater inter board collaboration to reap the economies of scale and scope may be explored.

4. Plan schemes may best be prepared based on consultations with all stakeholders.

Legal framework & Synergy with State Governments

The legal framework which governs production and marketing of plantation crops is governed by the Central Government. The international agreements entered into by the Central Government also affect this sector as has been evidenced by the IAFTA. However the effectiveness of the initiatives taken by the various commodity boards depends on the synergy with the State Governments and the conducive environment provided therein.

The Rubber Act (1947), Rubber Rules (1955) and the Rubber (Amendment) Act 2009 have been effective in stimulating the various players in the rubber scenario according to the researchers.

However, the case is not so with the Spices Board. Some of the major issues identified are as below.

- Spices Board has the mandate to look after export promotion in 52 crops (ie., export promotion and nothing to do with promotion of production.). Thus except in case of cardamom and to a limited extent in black pepper, the Board follows the policy of "harvesting without sowing" which tends to be unsustainable.
- Almost one -third of the cardamom growers in Idukki do not have title deeds to their land which creates problems in access to credit and other institutional support.
- Existing laws do not permit crop diversification and tourism in plantations.
- Significant inter state variations in taxes levied, which in turn affect competitiveness of growers of certain states.
- High electricity charges are levied on driers. Lowering rates will facilitate promotion of electric driers thus preventing cutting of trees for fuelwood.
- The present credit limit is Rs 3 lakh/ha and banks other than nationalized banks charge interst @ 12 % which is very high.
- E -auction has been helpful in better price realization, but delay in payment beyond 14 days is a matter of grave concern.
- Practice of taking same quantity of sample from all lots irrespective of size in effect reduces the price received by small growers.

Recommendations

1. Benefits provided to cardamom growers may be extended to all growers.
2. Spices Board shall consider an internal restructuring to form divisions/ departments of smaller groups of crops.
3. Formation of farmer groups in all crops may be thought of
4. Laws governing land utilization may be changed to enable crop diversification and facilitate plantation based tourism.
5. Land title issue in Idukki may be addressed.
6. The credit limit may be raised and rates of interest lowered.
7. Reduced electricity tariff for driers may be considered.
8. The report endorse the view of the Rangachari Committee (2006) and calls for greater state intervention in Infrastructure development so as to augment the competitiveness of the sector.
9. Amend the cardamom marketing rules so that lower quantity of sample can be taken from smaller lots. Delay in payment may be reduced.
10. In the case of natural rubber prices now are fixed based on visual assessment of quality of sheets which is unscientific and unsatisfactory to the farmers. A more scientific method of quality assessment is needed.

Development Regimes: Subsidised replanting, rejuvenation and other schemes.

All perennial plantation crops go through 4 stages in their life cycle - an initial pre-bearing period, early bearing period peak bearing period and a final senile phase when yield declines. Timely replanting hence is crucial to maintain production and productivity. Of equal significance is the survival strategy (or rather the struggle to survive) of the small holder to tide over the gestation (early pre bearing) period. The issues are relevant in both spice crops and in natural rubber. These issues and the mechanisms through which the commodity boards address them are looked into in this paper.

In small cardamom about 10 % of the area is to be regularly replanted every year to maintain productivity but much less is being carried out now. The main reason identified is the large number of small and marginal farmers reluctant to replant as they are unsure of the means to tide over the gestation period.

The various promotional schemes of the Spices Board are discussed of which the major are outlined below.

- Spices board provide subsidy along with technical support for new planting, replanting as well as rejuvenation. Subsidy covers 33% and 25 % cost of replanting & maintenance during gestation period in Kerala and TN.
- Set up certified nurseries in grower's fields under Spices Board guidance. Sucker multiplication is done in Kerala

  Irrigation and Land Development. Farm ponds and well irrigation equipment, soil and water conservation works, Subsidy - 20 -25 % of unit cost approved by NABARD.
- Rain water harvesting devices -Silpaulin lined dug pits of 200 m3. Cost - 16000 (digging), 8000 (silpaulin) - Rs 24000. Subsidy - Rs 8000/-
- Training programme for quality improvement.
- Organic farm certification

  50% cost of certification provided to individual farmer/processor (max- Rs 25000).

NATURAL RUBBER

Traditionally production oriented towards domestic consumption, but with globalization and removal of tariff and non-tariff barriers, the production has been exposed to greater international competition. The Rubber Board's promotional schemes are given below.

- Replanting subsidy - Rs 24500/ha (20 % of cost of cultivation).Assistance limited to 2 ha in traditional area & upto 20 ha in non traditional area. Paid in 6 annual installments. New planting - same rate as above.
- Rubber Board has 1 central nursery and 8 regional rubber nursery - can meet only around 10 % of the total planting material need.
- Supply of other inputs - Rain guard (15 % increase in yield), PP chemicals - CU oxychloride, Cuso4 and spray oil, Adoption of scientific tapping practice and application of stimulant ethiphone to increase yield.
- Soil and water conservation - silt pit - Rs 3000/ha.
- Farmer group formation and empowerment. - 2184 RPS & more than 50 SHGs formed.

Based on discussion with the growers the following points are raised by the researchers.

- ➢ No institutional mechanism to check the quality of planting material. Certification/ licensing of private nurseries by RB must.

- ➢ Need training to workers to mix fungicide and use of sprayers
- ➢ Action proposed - Formation of labour bank including women. Searching ancillary sources of income from rubber plantations.
- ➢ In the case of spices certification system for biofertilisers is urgently needed.
- ➢ Excessive use of pp chemicals can be deleterious - awareness creation needed.

It appears from the discussion that there is hardly any sphere of production/ processing which remain unattended today, though in some areas like Good Agricultural Practices and in provision of quality planting material more attention is warranted.

Some recommendations to strengthen the replanting works are given below.

- A system of base subsidy depending on no of plants and a supplementary subsidy on basis of performance.
- A higher subsidy proportional to the other producing nations also can be thought of especially for new planting.

Areas for further detailed analysis are

- the farmers' decision making related to replanting.
- the returns to the money spent on subsidy vis-à-vis its alternative uses like price stabilization Fund.

Research, Development and Extension

Unlike in the case of Natural Rubber where research and development is done by only a single agency (with effective linkages and liaison with sister institutions), there is considerable duplication of research efforts in spice crops.

Indian Cardamom Research Centre, Myladumpara, Idukki, Indian Institute of Spices Research, Calicut and the KAU are presently doing research, development and extension in case of spices. Effective interaction among various institutions/ actors in Spices R & D needed. Multidisciplinary multi-institution research can be thought of to come out with effective remedies for location specific problems.

The lacunae identified with respect to research in Spices are:

- ❖ Low diffusion of ICRI varieties (only 5 %). Private farmer varieties widely accepted.

- ❖ R & D expenditure per ha is higher for cardamom. R & D expenditure per scientist in case of cardamom and rubber is comparable. Perhaps the larger scale of R & D in natural rubber might have been instrumental in enabling RRII to have a better R & D outcome.
- ❖ Socioeconomic aspects haven't got much research coverage especially in spices. Should be recognized.
- ❖ Spices also lack database which is essential for the market as well as for planning.

In case of NR, RRII 105 was widely accepted and pop followed- hence productivity jumped. Problem of tapping panel dryness has to be addressed.

Paper warns of the possibility of an emerging substitute for natural rubber, which may drastically pull down the prices. A contingency plan- perhaps a pulse variety to be cultivated in the interspaces through biotechnology may be thought of.

A plantation modernization fund of Rs 5000 cr is recommended for modernization of plantation sector along with enhancement of R & D (ICT, Conservation and use of traditional varieties, New processing techniques/ devices).

Farmers' concern

Spices Board claim that weather based crop advisory services are provided through field offices but farmers were not aware of it.

5000 ha is reportedly under vanilla. But spices board has no idea on what is the production and what is the price?

Landholding pattern and Organizational redesign

There is small holder dominance in the plantation sector. In NR, 89 % area and 92 % production come from small holders with average holding size of 0.5 ha.

Only about 10 % area and 7 % total production come from estates. Though data is not available the same is the case with cardamom also.

Small holders are unequally placed in the value chain with a negligible share of the consumer's rupee and hence more proactive interactions from the commodity boards are sought to make them more economically viable.

Tea :

1. Bought in tea leaf factories - combines the economic advantage of family based production and corporate based processing and marketing.

2. SHGs

3. Tata tea - worker's participation in management.

In Cardamom and pepper - no groups - possibility may be explored.

Setting up of Spices park is a good initiative of the Spices Board. Board shall also aim at brand building to have greater access in international market by harnessing geographical indications.

Contract farming has both pros and cons - small farmers always will be at a disadvantage - so opt for farmer groups to reap the benefits of contract farming.

India imports green pepper in a large scale under advance licensing scheme for domestic value addition and export. This may weaken the domestic plantation sector. Institutional arrangements for collecting green pepper from the individual farms and making available to green pepper factories may help the sector.

Green pepper loss is considerable due to shortage of labour. This can be prevented also.

Recommendations

- ➢ The practice of importing green pepper for domestic value addition should be replaced with domestic supply through forming farmer groups for collection and supply.
- ➢ Possibility of brand building in spices to be explored. Access international markets through obtaining geographical indications.
- ➢ Organise farmers into groups and explore possibility of contract farming.

Trends in area , production and productivity

Cardamom - decline in area, increase in productivity, and hence increase in production

Area decline - prospects of bringing new area under cardamom and following mixed cropping with fruit plants so as to enable farmers to avail carbon credits may be explored.

Regarding other spices - except chilly all other showed significant increase in area.

Poor yield is a problem in all spices except cardamom, chilly, coriander and ginger. Spices board has the mandate of export promotion, but export promotion without production enhancement is difficult. So the mandate has to be changed including production enhancement also.

Rubber

In the 1990s area, production and productivity showed decelerating trends, but revival since 2002, but with fluctuations. There is a general decline in rate of growth of production and productivity of rubber probably due to absence of timely replanting.

Decomposition analysis of output growth shows that upto 2002 output growth has been contributed mainly by area effect- since 2002 output growth was mainly due to yield effect.

Recommendations

- ❖ Mixed cropping with trees (as an alternate source of income as well as of carbon credits) may be adopted in cardamom.
- ❖ Alternate strategies to increase the income from unit area of rubber may be designed.
- ❖ Analysis of the factors that contributed to significant swings in the contribution of area and yield effect on output growth during the post 1990 period must be done.

Commodity price instability/ Cyclicality

Price instability creates uncertainty - cause negative effect on investment and growth - indebtedness of farm households - decrease in employment opportunities of ag labour - increase in poverty.

This reduces investment on land and in adoption of technology

Production and productivity are adversely affected.

Factors leading to ag price volatility

1. Imperfections in information relating to supply and demand
2. Hedging and speculation
3. Most important - supply shocks due to adverse weather - due to limited investment in irrigation and land development.

Remedial measures

Government intervention through procurement, msp, protection from imports had been followed but the impact had been lessened by the reforms in the last decade.

Analysis reveals that there are considerable instability in price for both NR and spices.

Gov of India set up a Price stabilization Fund in 2003.

lakh small holders with operational holdings less than 4 ha were intended to be covered.

Corpus of 500 cr with 482.88 cr from centre and 17.72 cr non refundable initial contribution from participating growers @ Rs 500/. Interest is used for price stabilization fund scheme- annual interest released to NABARD.

Operation:

1. In distress year, gov deposits Rs 1000 per grower - can be fully withdrawn.
2. Normal year - Gov and farmer deposit Rs 500 each. No withdrawal
3. Boom year - Farmer deposit Rs 1000. No withdrawal. Only 8.2 % - 28809 growers joined the scheme. Poor response from farmers due to very poor compensation offered. Raise corpus to Rs 10000 crore such that a compensation of at least Rs 20000 can be given.
4. Contribution of farmers can also be made proportional to increase in price beyond threshold level.
5. This is not operational in cardamom

Recommendations:

- ❖ Commodity crises need to be taken up in South South forums.
- ❖ International commodity boards for price stabilization, through supply management, common brand building, joint marketing and research can be helpful.
- ❖ Interactions at farm level:
- ❖ Adverse effects of price instability become intense when grower depends on a single crop. Inter commodity board collaboration to promote mixed cropping (mixed farming)
- ❖ Development of crops suited for intercropping in plantations.
- ❖ More enquiries into the reason for price fall during peak season despite heavy demand needed.
- ❖ Rubber Board has to protect the interest of both producers and consumers of rubber. The ruling high price is said to adversely affect downstream industries.
- ❖ More scientific methods of deciding quality and price may be devised.

Export orientation

With the growing importance of the services and manufacturing sector the share of primary ag sector in total trade has declined over the years, from 10.64 % in 70-75 to 1.37 % in 2007-08. However, plantation sector still plays an important role in ag exports from the country. It accounts for over 15 % of the total ag exports from the country.

High labour intensity, concentration in backward and fragile ecosystems, domination of small and marginal farmers makes the sector vital for the proposed intensive growth strategy. Ability to support inclusive growth depends to a great extent on its export competitiveness. State intervention is hence warranted.

1. Employment pattern and intensity.

   Plantations of primary commodities are concentrated in a few states and hence very important in these regional economies. Estate sector alone provide about 2.5 million days of employment and a major chunk of it is female.

2. Backward and ecologically fragile areas. & infrastructure deficit stands in the way of export competitiveness

   In Assam, Kerala, Karnataka tea plantations are concentrated in the least developed districts of the State.

3. Dominance of small and marginal farmers.

Export intensity

Among 10 spices intensity increased for large cardamom, chilly, turmeric, coriander, fenugreek & cumin. Declined / remained stagnant for small cardamom, black pepper, ginger, garlic and fennel.

Interventions of Spices Board

Improved curing devices, promotion of organic cultivation, hygienic and good ag practices.

In spices there is a disjuncture between production and export - the current strategy of harvesting without sowing may turn unsustainable.

Natural rubber is mainly an import substituting crop.

Domestic productivity may be enhanced to withstand potential import competititon.

Recommendations

Export oriented production measures for those crops which do not have one now.

Need for common brand building - India should become a global hub for processing and domestic value addition for exports.

In NR strive to enhance productivity and production to withstand import competition from other countries and also to enter the world market.

Export competitiveness and IAFTA

The IAFTA may indeed be beneficial to the plantation sector or at least will not do more harm than the already existing provision of duty free import in these commodities did.

ASEAN India vision 2020 calls for setting up of India ASEAN commodity boards for price stabilization through supply management, brand building, joint marketing and research and other mutually beneficial initiatives.

Prices of these commodities are not decided by imports alone but by international demand and supply forces. Hence where individual countries could so far not sort out the commodity problems, the association may be able to address the same in a better and more efficient way. The immediate need hence is to bridge the efficiency gap in the sector across countries.

Issues in the sphere of production, processing and marketing, labour and employment, ag research and extension, diffusion of innovations, infrastructure build up, human capital development, coordination between different players are to be addressed.

Most of the recommendations of the Swaminathan commission on WTO concerns are yet to be implemented.

It is important to device appropriate adjustment assistance schemes for planters as well as workers who might be displaced.

Recommendations

Appropriate adjustment assistance schemes for planters as well as workers who might be displaced on account of FTA.

Concerted effort towards evolving a vibrant and internationally competitive system of innovation and production.

Set up initiatives like the spices park in other crops as well.

Constructive cooperation among the participating countries in FTAs and CECAs for mutual benefit can be thought of.

Greater coordination among the ministries of commerce and External Affiars for taking up the commodity issues in appropriate forums.

Social Cost in Plantation Sector

Two provisions

1. Plantation labour act: Employers have to provide drinking water, bbbb and medical facilities.

   Welfare- canteens, crèche, recreational facilities, educational facilities, housing, liability of employer in accidents

2. Welfare schemes of commodity boards

   Rubber board- Stipend for higher education of children, merit award

   Health and medical reimbursement, group and health insurance (more than 80 % small holders are themselves tappers.

Spices Board

Educational stipend to children of cardamom estate workers & grant in aid for hospital/educational institutions.

Though provisions are like this there has been a progressive reduction in the number of plantations reporting returns to PLA from 55% TO 47 % DURING 1999 TO 2006. This is attributed partly to a laxity on the part of the state as well as on the fact that the provisions are against the interest of the planters.

So greater proactive involvement of the estate in the social welfare provisions of the plantation labour is called for enforcing 50 % share of planters.

Recommendations

Labour welfare activities may be reviewed.

A suitably designed study may be conducted from the perspective of inclusive development based on primary data and field level evidence to follow up on the suggestions of social provisioning.

Labour shortage

In general, plantation sector faces severe labour shortage - two sets of problems

1. poor performance of tea and coffee sectors - due to poor and low wages.

2. rubber - performing well but not enough workers due to poor wage structure.
3. Minimum wage in construction sector is much higher than min wages in ag & plantation sector. Hence even migratory labour goes to that field.
4. Boom in the construction sector also has been detrimental to plantation labour availability.
5. Successful implementation of NREGS which has attracted large number of labor esp. women who would have been engaged in ag.'

Recommendations

1. Introduction of productivity linked wage system
2. Formation of labour bank
3. NREGS - treating plantation work on par with creation of social assets.
4. Provide health insurance, education, housing and sanitation to workers.
5. Development/Adaptation of machines suited to plantation sector.
6. Housing colonies and schools in Tamil medium for labour.
7. Plantation sector and work process to change in such a way that it can attract younger generation.

Climate change: Challenges and Opportunities

Plantations are mostly located in ecologically fragile locations. Studies shows that the felling of trees for fire wood as well as for sale in periods of price fall are deleterious to environment. Adverse effects of excess chemicals also add to global warming in addition to environment and health hazards. This can have adverse impact on the export market. Hence boards promote organic farming (GAP). Further research on the nexus between ecology and economy needs to be carried out.

The Kyoto protocol and how our farmers can benefit from it are also discussed in the paper.

Kyoto protocol

Annex I countries (developed) to bring down their collective CO2 emission levels at least 5.2 % below their 1990 levels by 2008-12.

3 market mechanism have been established

1. International emission trading

2. Joint implementation of emission reduction

3. Clean development mechanism

While first two can be operated only among annex I countries, CDM can be implemented by annex I countries in developing and LDCs. Aims to bring funds from annex I countries to these countries for environment friendly projects. This will earn the annex I country CER (Certified emission reduction) credits or carbon credits that can be used by them to partially offset the Kyoto targets. '

Growth and sustainable management of trees and forests is one method of CER.

The following suggestions are made in this regard.

- Attract CDM funding through use of biomass gassifier, biogas production from latex processing effluents and use of rubber seed oil as bio-diesel
- Rubberised roads are more fuel efficient and energy saving. The additional cost of rubberized roads can be met from potential CDM cash flow
- The possibility of growing NR in degraded region with the exclusive aim of supplying into markets where it will substitute synthetic rubber can attract CER credits. Revenue from sale of NR and CERs will fund the project.
- More area may be brought under cardamom by planting shade trees and ensuring CERs.

Pesticide Use in Kerala and trade barriers - a critical analysis

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International trade in food products has expanded enormously over the last decades, fuelled by changing consumer tastes and advances in production, transport, and other supply-chain technologies. However, this growth is accompanied by increasingly stringent food safety standards in developed countries, which pose major challenges for developing country's success in international markets. Also there exists widespread uncertainty over how the developing countries are enforcing their standards. India's drive to increase food exports is being impeded by pesticide residues, unacceptable in importing countries. Public concern, about the presence of pesticides in food, drinking water, and the environment has also increased in recent years. As a result, greater attention has been given to the various laws that regulate the use of pesticides and maintaining safety of the food products, water and environment.

The Insecticides Act, 1968 and Insecticides Rules, 1971

The act regulates the import, registration process, manufacture, sale, transport, distribution and use of insecticides (pesticides) with a view to prevent risk to human beings or animals and for all connected matters, throughout India. All insecticides (pesticides) have to necessarily undergo the registration process with the Central Insecticides Board & Registration committee (CIB & RC) before they can be made available for use or sale. The Registration certificate mandates that a label should be put on the packaging, which clearly indicates the nature of the insecticide (Agricultural use), composition, active ingredient, target pest(s), recommended dosage, caution sign and safety precautions.Insecticide rules are framed to enforce the act and it came in to force wef 9/10/1971. Both can be downloaded from http://cibrc.nic.in/insecticides_act.htm. and http://cibrc.nic.in/insecticides_act.htm.

Registration Procedure of insecticides

An application for registration of an insecticide under the Insecticide Act shall be made in Form I and the said Form including the verification portion, shall be signed in case of an individual by the individual himself or a person duly authorised by him. An application form duly filled together with a bank draft of Rs. 100 only, drawn in favour of the Accounts Officer, Directorate of Plant Protection, Quarantine & Storage, payable at Faridabad towards registration fee shall be sent to the Secretary, Registration Committee, Directorate of Plant Protection, Quarantine & Storage, NH-IV, Faridabad-121001, Haryana. One self addressed stamped envelope and one stamped envelope must be enclosed along with the application. On receipt of any such application the Committee may, after such inquiry and after satisfying to which the application relates conforms to the claims made by the importer or by the manufacturer, will allot a registration number and issue the certificate of registration in Form II or Form II-A, as the case may be. The details of registration procedure are available in the official website http://cibrc.nic.in. Online registration facility is also available with the website address http://pesticides-registrationindia.nic.in.

The new pesticides management bill, 2008

This bill repeals the Insecticides Act, 1968. The standing committee report of the bill is placed in the parliament on 18 February 2009 and is to be passed in Rajya sabha & Lok sabha. The purpose of the bill is to regulate the import, manufacture, export, sale, transport, distribution, quality and use of pesticides with a view to

(i) control pests;

(ii) ensure availability of quality pesticides;

(iii) allow its use only after assessing its efficacy and safety;

(iv) minimize the contamination of agricultural commodities by pesticide residues;

(v) create awareness among users regarding safe and judicious use of pesticides, and to take necessary measures to continue, restrict or prohibit the use of pesticides on reassessment with a view to prevent its risk on human beings, animals or environment, and for matters connected therewith or incidental thereto.

One has to apply to the Registration Committee for registration in order to manufacture, import or export pesticides. The Registration Committee may suspend the registration certificate for a maximum period of three months if it is satisfied that any violation of the provisions of the Bill has taken place. It may also inspect the manufacturing premises or processing facilities of the registrant and cancel the certificate if found inadequate. An order of refusal, suspension or cancellation of

registration certificate may be appealed to the Central Government within a period of 30 days.

Any person who wants to manufacture or sell pesticides or undertake commercial pest control operations with the use of pesticides may apply for a licence. The State Government may appoint licensing officers to grant such licences in the prescribed manner. The officers shall (a) maintain a register of persons engaged in manufacture or sale of pesticides; (b) provide information to the State Government on performance of registered pesticides; and (c) provide information to the State Government on infrastructure facilities of manufacturers. The licence may be evoked or suspended on grounds specified in the law. If an insecticide or batch of insecticide is found as a threat to the human beings, animals and environment, the State Government should notify it in the Official Gazette according to Section 27 of the Act and ban the use or sale of insecticide for a period of 60 days or up to a maximum of 90 days. The decision can be appealed with such authority as prescribed. The Central Government may establish a Central Pesticides Laboratory under a Director and can accredit private laboratories to carryout the same functions as the Central Pesticides Laboratory. The Central or State Governments may appoint pesticide analysts and pesticide inspectors in the prescribed manner.

A Pesticide Inspector shall have the power to enter and search a premise if he has reason to believe that a violation of the law has taken place; to take registers and records maintained by the manufacturer; to stop the distribution, sale or use of pesticide with the permission of the Executive Magistrate; and to take samples of any pesticides and send it for analysis by a pesticide analyst within 48 hours. The Bill also mentions the procedure to be followed by the pesticide inspector in commission of his duties. It also states that the pesticide analyst shall furnish his report within 45 days. In Kerala, the Assistant Director of Agriculture or Agricultural officer is in charge for handling the duties of pesticide inspector. The State Government requires any person to report all occurrences of poisoning through handling of pesticides coming within his cognizance. The Bill lists a number of penalties for offences such as use of pesticide in contravention of the law and sale of misbranded or sub-standard pesticide.

Banned Pesticides in India

The CIB & RC scrutinizes and periodically reviews all pesticides and their usage, some are banned from registration itself. Sometimes a pesticide can be banned even after registration when it causes serious environmental and public health concerns. Some pesticides are meant for "Restricted Use" which means that they can be used only for prescribed purposes and by authorised personnel by obtaining the appropriate Government license. There were 230 pesticides including 10 biological/ botanical pesticides registered for use in India as on 17/06/2011. There are 28 pesticides banned for manufacture, import and use eg., Aldrin, BHC etc. 2 pesticide

/ pesticide formulations banned for use but their manufacture is allowed for export, 4 pesticide formulations ban need for import, manufacture and use, and 8 pesticides withdrawn. Eighteen pesticides were refused registration and 13 are restricted for use in India. Extremely toxic insecticide like methyl parathion and monocrotophos come under the category of restricted use. Fenitrothion and fenthion are restricted for household use only. DDT is another example of a restricted pesticide which is permitted to be used in public health ie., for control of mosquito and banned for agricultural use.

Ban of insecticide by Government of Kerala

As on today endosulfan is also in this category, as its sale and use were banned in Kerala state with effect from 31st October 2006 vide notification No.S.O1874(E) issued by the Ministry of Agriculture, Govt. of India. Very recently the supreme court of India has banned its production, use and sale all over India for a period of 8 weeks with effect from 13/05/2011 vide interim order in the writ petition (civil) number 213 of 2011 to appoint a joint committee headed by the Director General of ICMR and the Commissioner,Agriculture to conduct a scientific study on the health hazards caused by endosulfan and ordered to submit its interim report within eight weeks with effect from 13/05/2011. The supreme court has ordered immediate ban of production, sale and use all over India till the above report is submitted by the expert committee.

On 2010 December 2, all red and yellow labelled pesticides in Kasargod district were banned in the light of the endosulfan issue. Separate guidelines to regulate distribution and use of pesticides in the state of Kerala were issued in a subsequent G.O (MS) No. 22/2011/ Agriculture dated 17-01-2011 where prescription based recommendation of pesticides was introduced for the first time in the state or even in the country. According to GO (Rt) 99 / 2011, on 12-1-2011 an expert committee with Director of Extension, KAU & Additional Director (Crop Production) KAU, Agriculture Department, Research organisations , THANAL representatives as members, was constituted by the intervention of KAU and meetings were conducted on 7th & 22nd February 2011. Committee decided to have a detailed evaluation on the toxicology profile of all insecticides, fungicides and herbicides including water solubility, toxicity to mammals, ecotoxicology (Birds, fish, beneficials, honeybees, earthworms, nontarget), persistence in soil and crops, maximum residue limit of pesticides. Based on the committee's recommendations, the government issued ban on all red labeled insecticides except rodenticides and two yellow insecticides (triazophos and profenophos), three fungicides(ediphenphos, tricyclazole and oxythioquinox) and four herbicides (anilophos, paraquat dichloride, thiobencarb and atrazine). The latest government order on banned insecticides and the interim recommendation on substitutes for each are available as GO ms 123_11 in the webpage http://www.kerala.gov.in.

LIST OF PESTICIDES / PESTICIDE FORMULATIONS BANNED IN INDIA

Pesticides Banned for manufacture, import and use (28 Nos.)

Sl.No.	Name of pesticides	Sl.No.	Name of pesticides
1	Aldrin	15	Pentachlorophenol
2	Benzene Hexachloride	16	Phenyl Mercury Acetate
3	Calcium Cyanide	17	Sodium Methane Arsonate
4	Chlordane	18	Tetradifon
5	Copper Acetoarsenite	19	Toxafen
6	CIbromochloropropane	20	Aldicarb
7	Endrin	21	Chlorobenzilate
8	Ethyl Mercury Chloride	22	Dieldrine
9	Ethyl Parathion	23	Maleic Hydrazide
10	Heptachlor	24	Ethylene Dibromide
11	Menazone	25	TCA (Trichloro acetic acid)
12	Nitrofen	26	Metoxuron
13	Paraquat Dimethyl Sulphate	27	Chlorofenvinphos
14	Pentachloro Nitrobenzene	28	Lindane*

*Banned vide Gazette Notification No S.O. 637(E) Dated 25/03/2011)-Banned for Manufecture,Import or Formulate w.e.f. 25th March,2011 and banned for use w.e.f. 25th March,2013.

B. Pesticide / Pesticide formulations banned for use but their manufacture is allowed for export (2 Nos.)

Sl.No.	Name of pesticides
29	Nicotin Sulfate
30	Captafol 80% Powder

C. Pesticide formulations banned for import, manufacture and use (4 Nos)

Sl.No.	Name of pesticides
1	Methomyl 24% L
2	Methomyl 12.5% L
3	Phosphamidon 85% SL
4	Carbofuran 50% SP

D. Pesticide Withdrawn (7 Nos)

Sl.No.	Name of pesticides
1	Dalapon
2	Ferbam
3	Formothion
4	Nickel Chloride
5	Paradichlorobenzene (PDCB)
6	Simazine
7	Warfarin

E. Pesticides refused registration

Sl.No.	Name of pesticides
1	Calcium Arsonate
2	EPM
3	Azinphos Methyl
4	Lead Arsonate
5	Mevinphos (Phosdrin)
6	2,4, 5-T
7	Carbophenothion
8	Vamidothion
9	Mephosfolan
10	Azinphos Ethyl
11	Binapacryl
12	Dicrotophos
13	Thiodemeton / Disulfoton
14	Fentin Acetate
15	Fentin Hydroxide
16	Chinomethionate (Morestan)
17	Ammonium Sulphamate
18	Leptophos (Phosvel)

F. Pesticides restricted for use in India

Sl.No.	Name of pesticides	Type of Restriction
1	Aluminium Phosphide	3g tablets in cage packing and powder form in pouch permitted for use in rat burrows
2	DDT	Banned in agriculture; Permitted only for domestic public health program upto 10,000 MT per year
3	Lindane	Permitted for use in termite control upto 24-03-2013
4	Methyl Bromide	To be used only by Govt. under strict supervision of Govt Expert or pest control operator
5	Methyl Parathion	Permitted only on crops where honeybees are not acting as pollinators
6	Sodium Cyanide	Permitted only for fumigation of cotton bales by Plant Protection Adviser to Govt. of India under expert supervision
7	Methoxy Ethyl Mercuric Chloride (MEMC)	Permitted only for seed treatment of potato and sugarcane
8	Monocrotophos	Banned in vegetables
9	Endosulfan	Banned in Kerala State
10	Fenitrothion	Banned in agriculture except for locust control and in public health
11	Diazinon	Banned in agriculture except for household pest control
12	Fenthion	Banned in agriculture except for locust control, household pest control and public health
13	Dazomet	Banned in tea.

Source: http://cibrc.gov.in/list_pest_bann.htm

Pesticide residue in various food samples

Pesticides are used to ensure protection of food crops from harmful pests. However, residues may appear in food, and where they do, generally not exceeding approved levels. Of the 2024 samples tested in the Pesticide Residue Research and Analytical Laboratory (PRRAL) under Kerala Agricultural University located at College of Agriculture, Vellayani, only 124 samples (6%) were contaminated. Twenty five food commodities (94%) collected from market were not contaminated with pesticides. Pesticide contamination was found in 6% ie., 15 food commodities (cowpea, amaranthus, capscicum, bittergourd, bhindi, cumin seed, curry leaf, cardamom, basmathi rice, chilli, cauliflower, brinjal, wheat,cabbage and pepper) collected from the market. Highest contamination of fungicides & insecticides was in cumin seed with 12 pesticides. High levels of contamination with profenophos , endosulfan ,carbofuran, quinalphos, bifenthrin, cyfluthrin, cypermethrin, fenpropathrin ,thiamethoxam ,carbendazim etc. in curry leaves was observed in

samples obtained from neighbouring states. This pesticide dumping in curry leaf farms is done against pests like scale insects, jumping plant lice (psyllids), aleyrodids, leaf caterpillar (Papillio sp.) etc. Seven pesticides were detected in a single sample packet of Cardamom collected from local market in Quilon.

Rigid global standards exist for pesticide approval and use, as defined by bodies such as the Food and Agriculture Organisation of the United Nations (FAO) and the World Health Organisation (WHO) through instruments such as the Codex Alimentarius. In order to protect the health of the consumer while facilitating international trade, the Codex Alimentarius Commission (Codex) has established Maximum Residue Limits (MRLs) for individual pesticide in selected food commodities The MRL is the maximum concentration of pesticide residue legally permitted in or on food commodities or animal feeds. It is expressed as ppm in foods and ppb in drinks. Maximum Residue Levels (MRLs) mark the authorised pesticide limit in food products and are set individually for each pesticide and in each crop. The primary objective of setting MRLs is to encourage the trade, to observe good agricultural practice to ensure that only the minimum amount of pesticide is applied to food for achieving pest control need, thereby protecting the health of consumer. In India Maximum Residue Limits of 121 pesticides is fixed & notified by the Ministry of Health & Family Welfare.

Food Safety and Standards Act, 2006

Ensuring food safety has been recognized as an important component in global trade and in protecting the health of the people. Various acts were formulated to monitor the standards of quality and purity of different food products. Prevention of Food Adulteration (PFA) Act, 1954 was the most important regulation ensuring food safety and quality in India and thereby safeguarding the interest of consumers. Food Safety and Standards Act, 2006 will consolidate all the laws relating to food and to establish the Food Safety and Standards Authority of India for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import, to ensure availability of safe and wholesome food for human consumption and for matters connected therewith or incidental thereto. FSSA will be advised by a network of scientific panels and a central advisory committee to lay down standards for food safety. These standards will include specifications for ingredients, contaminants, pesticide residue, biological hazards and labels. The Food authority and the State Food Safety Authorities shall be responsible for the enforcement of this Act. The Central Food Safety and Standards Authority and the State Food Safety Authorities shall monitor and verify that the relevant requirements of law are fulfilled by food business operators at all stages of food business.

Decontamination of Residues

Pesticide application is inevitable at some or few stages in crop management

practices. Pesticides enter the human body through inhalation, skin and through various food products especially fresh fruits and vegetables. At this juncture, we should make sure the safety of food commodities especially the fruits and vegetables we consume in our daily routine. This is made possible to a large extent by some of the simple domestic decontamination procedures which can reduce the pesticide load in raw agricultural commodities to a larger extent.

Basmathi rice and wheat grains were occassionally contaminated with organophosphate and pyrethroid insecticides viz, methyl parathion, chlorpyriphos, cypermethrin, fenvalerate etc. To decontaminate basmathi rice, three or four washings in tap water with rubbing of grains by hand followed by soaking in water for 6 hours and one more washing will be enough . Cooking helps to eliminate 40-50% of surface residues. Wheat may be subjected to 2 - 4 washings in tap water with rubbing of grains by hand followed by sun drying and milling to wheat flour to reduce the pesticide residue. To remove insecticide residues from vegetables especially cowpea, amaranthus, capsicum, curry leaf and okra, washing with solutions of household products can be done. Dipping vegetables (cowpea, amaranthus, bittergourd, capsicum, cauliflower, bhindi, green chilli and curry leaves) in the solutions of household products for 5 -10 minutes and washing them in tap water will reduce the pesticide load considerably. The best treatment to remove upto 60-80% of pesticide residues in vegetables is by dipping in 2% tamarind solution or 2% vinegar for 5-10 minutes followed by washing. 1% turmeric solution or butter milk or luke warm water can also be used for decontamination.

It is impossible to revert to a pesticide free lifestyle but this isn't necessarily a bad news. The perfect pesticide still doesn't exist, however newer pesticides with green labels eg. rynaxypyr, flubendiamide etc. safer to environment can be used for controlling lepidopteran pests. These green labeled insecticides are safer to mammals, natural enemies, narrow spectrum, highly selective and only very low dose (5 to 100 g ai/ha) is required. Therefore we should adopt a holistic approach to address the problems concerned with pesticides as a threat to global food trade.

SIGNIFICANCE OF INTELLECTUAL PROPERTY RIGHTS IN AGRICULTURE

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Intellectual Property Rights (IPR) have become important in the face of changing trade environment which is characterized by features like global competition, high innovation risks, short product cycle, need for rapid changes in technology, high investments in research and development and need for highly skilled human resources. Intellectual Property is loosely defined as the 'Product of Mind'. It is a class of property emanating primarily from the activities of the human intellect. It is similar to the property consisting of movable or immovable things, which can be used by the owner alone and not lawfully by others without owner's permission.

Governments grant intellectual property rights to the owners or creators of inventions, designs and literary or artistic material to protect their ideas and innovations from being used illegally by others. The owner of intellectual property can control and be rewarded for its use. IPR encourage further innovations and creativity and promote investment in research and development. IPR can be traded in the same way as goods or services and are an important part of international trade. Their importance is increasing as the effective use of knowledge contributes substantially to national economic prosperity.

Nature of IPR

IP is simply the property created by the application of human mind, is intangible and derives its values from ideas. IPR are awarded by Government and are monopoly rights implying that no one can use these rights without the consent of the right holder. IPR can be assigned, gifted, sold and licensed like any other property. The IP relates to information, which can be incorporated in tangible objects and reproduced in different locations. The enforcement of the rights on the IP is termed as IPR and is governed by the laws of IPR.

Talk delivered in the NAIP National Training Course on Protection and Management of Intellectual Property Rights in Agriculture on September 20-29, 2011 at the College of Horticulture, Kerala Agricultural University.

IPR are largely territorial rights (applicable in the country where the right is granted) except copyright, which is global in nature. It is important to know that these rights have to be renewed from time to time for keeping them in force except in case of copyright and trade secrets. IPR have fixed term except trademark and geographical indications, which can have indefinite duration provided these are renewed after a stipulated time specified in the law by paying prescribed fees. Unlike other movable and immovable properties, these rights can be simultaneously held in many countries at the same time.

The Marrakesh Agreement of 1994, that established the World Trade Organization included the Agreement on Trade Related Aspects of Intellectual Property Rights (more commonly referred as TRIPS), which formally recognized the importance of IPR in the global economy. The agreement is intended to maximize the contribution of IP system to economic growth through trade and investment.

The TRIPS agreement recognizes seven kinds of IP. They are

- Patents
- Copyrights and related rights
- Trademarks
- Geographical Indications
- Industrial Designs
- Layout Designs of integrated circuits
- Protection of Undisclosed information (Trade secrets)

Patents:

Patents are legal rights granted for new inventions employing scientific and technical knowledge. It is the exclusive right granted by a country to the owner of an invention for a limed time, to make, use, manufacture and market the invention, provided the invention satisfies certain conditions stipulated in law. Patents are very useful as they can be utilized as devices to advance knowledge and bring new knowledge eventually into public domain. Protection of the IP by means of patent is recognized in the modern times as an important tool not only to promote inventiveness, but also to ensure adequate returns to the investment made.

International treaties that deal with the patents are Paris Convention for the Protection of Industrial Property (1883), Patent Cooperation Treaty (1970) and Budapest Treaty on the International Recognition of the deposit of Microorganisms for the purpose of Patent Procedure (1997) and TRIPS 1994. Article 27.3 of TRIPS states that "members may exclude from patentability – plants and animals other

than microorganisms and essentially biological processes for the production of plants or animals other than the non biological and microbiological processes". The criteria that are to be satisfied for an invention to be patented are "Novelty, Inventiveness and Usefulness".

In India, the patent rules were framed in "The Patent Act 1970". To save the interests of inventors, the British rulers enacted the Indian Patents and Designs Act, 1911. Since then due to substantial changes in the political and economic conditions of the country, it was found desirable to enact comprehensive law on the subject. The Patent Bill, 1953 was introduced in the *Lok Sabha* on 7th December, 1949, but it lapsed. The Patent Bill was again introduced in the Parliament in 1970. The Act was later amended in 1974, 1985, 1999, 2002 and 2005. The Patents (Amendment) Act, 2002 (38 of 2002) is a land mark in the history of patenting of living organisms in India. After this Amendments, inventions not patentable includes "plants and animals in whole or any part thereof other than microorganisms but including seeds, varieties and species and essentially biological processes for production or propagation of plants and animals" and also "a method of agriculture or horticulture". Moreover "an invention which in effect, is traditional knowledge or which is an aggregation or duplication of known properties of traditionally known component and components" is not patentable in India. From 1-1-2005 onwards product patent is operative in India in order to meet the obligations under TRIPS. India joined the Paris Convention and became a member of PCT on Dec. 8, 1998.

The Chakraborty case from USA is a land mark in the history of patenting of living organisms. In 1980, the American Supreme court ruled that a live, human made genetically engineered microorganism can be patented under the American Patent Laws as "manufacture" or composition of matter (Diamond vs Chakraborty case). In this patent the subject of claim by A. M. Chakraborty was a new strain of *Pseudomonas*, derived from natural isolates by genetic manipulations and capable of cleaning of oil spills.

Subsequently, patentability was extended to plants as well animals. In 1985, a patent was awarded to a maize variety overproducing tryptophan obtained through tissue culture. In 1988, a USA patent was granted to Harvard Onco Mouse - a transgenic mouse. The Basmati patent granted to Rice Tech (USA), in 1997, had invited worldwide attention.

An unambiguous definition of discovery and invention is essential for deciding the eligibility for protection through patents. Inventions have been considered for patents whereas discoveries have not. However in USA an isolated and purified form of a natural product is patentable if it is found in nature in a non-purified form. Similarly in Europe Patent Convention a patent can be when a substance found in nature can be characterized by its structure or by any other criteria if it is new in the sense that it was not available to public in that form. Such interpretations have

been used to patent gene sequences and isolates of DNA. No patents will be granted for mere sequences without indications of a function.

Protection of new Plant Varieties

Article 27.3 of TRIPs insist that the members are required to provide for protection of plant varieties either by patents or an effective *sui generis* system or a combination there of. In USA three different systems are available for protection of sexually propagated crops.

1. Plant Patent Act (1930) – covers variations of asexually propagated crops.
2. Utility Patents (1985) – considered being the most powerful and most expansive in scope of their coverage. A single patent may cover several varieties, an entire species/genus, genes/proteins or technology and processes.
3. Plant Variety Protection Act (1970) – protects the rights of plant breeders

Presently India has enacted the legislative for the protection of Plant Breeders Rights and Farmers' Rights under the "PPV & FR Act". This Act is aimed to provide for the establishment of an effective system for protection of the rights of plant breeders and farmers and to encourage the development of new varieties of plants. FAO had clearly given out the concept of Farmers' right. Starting as a concept for debate in 1979 in the FAO, the issue of farmers' right found its way through three FAO conference resolutions. These were negotiated by the Commission on Plant Genetic Resources (PGR) and unanimously adopted by over 160 countries in 1989 and 1991. The commissions defines Farmers Rights as "right arising from past, present, future generations of farmers, for the purpose of ensuring full benefits to farmers for supporting the continuation of their contributions". Internationally acceptable mechanisms for the implementation of farmers' rights are yet to be arrived at.

Features of PPV & FR Act, 2001

This Act recognizes and protects the rights of farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties. Varieties belonging to such genera and species as notified in official gazette will be included under the Act. Extant varieties, farmers' variety, new varieties and essentially derived varieties can be protected. Farmers' variety means a variety which has been traditionally cultivated and evolved by farmers in their fields. NDUS will be the criteria for registration. Under this act Act there is provision for benefit sharing based on the extent and nature of the use of genetic material of the claimant in the development of the variety relating to which the benefit sharing had been claimed. The commercial utility and demand in the market of the variety relating to which the benefit sharing has been claimed will also been taken into account. Rights of farmers as breeders,

cultivators and conservators of genetic material are also fully acknowledged. Farmers will not be entitled to sell branded seed of a protected variety.

On Nov. 10, 2005 the cabinet had cleared the block for implementation of PPV & FR by approving the creation of the post of Registrar General of the Authority set up under the Act.

Protection of Biological diversity

In December 2002 *Lok Sabha* passed the Biological Diversity Bill, 2002 "intended to provide for conservation of biological diversity, substantial use of its components and fair and equitable sharing of benefits arising out of biological resources, knowledge and for matters connected there with or incidental there to", in accordance with CBD.

Biological Diversity Act, 2002 gives guidelines for the regulation of access to biological diversity, establishment of regulatory bodies like National Biodiversity Authority (NBA), State Biodiversity Board (SBB), Biodiversity Management Committees, establishment of local biodiversity fund etc. The Bill also gives guidelines for "the determination of equitable benefit sharing arising out of the use of accessed biological resources, their byproducts, innovations and practices associated with their use and applications and knowledge relating there to in accordance with mutually agreed terms and conditions between the persons applying for approval, local bodies concerned and benefit claimers".

Geographical Indications

International treaty related to GIs is Libson Agreement for protection of Appellations of Origin and their International Registration (1958). "Geographical Indications" in relation to goods means an indication which defines such goods as agricultural goods, natural goods or manufactured goods as originating or manufactured in the territory of a country or a region or locality in that territory where a given quality, reputation or other characteristics of such goods is essentially attributable to its geographical origin and in case where such goods are manufactured goods, one of the activities of either the production or the processing or preparation of the goods concerned take place in such territory, region or locality as the case may be".

Examples of some registered GIs in India include Alleppey Green Cardamom, Malabar Pepper, Pokkali Rice, Darjeeling Tea, Aranmula Kannadi etc.

In Dec. 1999 Parliament passed the GIs of goods (Registration and Protection) Act, 1999. Any association of persons, producers, organization or authority established by or under the law can apply for the registration of GI. The applicant must represent the interest of the producers. The registration is for a period of 10 years. Renewal is possible for further period of 10 years each.

Copyright

Copyright is one of the main branches of IP. Copyright protection includes every production in the literary, scientific and artistic domain, whatever the mode or form of expression. Books, paintings, poems, novels, sculptures etc. known as literary and artistic works are protected under "Copyright". Copyright and related rights also protect audio visuals works, films, music etc. The rights under copyright include rights of reproduction, communication to the public and translation of work. It is not the idea that the copyright protects, but merely the expression of the idea as fixed in a particular form.

The laws on copyright aim to, protect an originator (author, inventor, designer etc.) from unauthorized use or exploitation of his/her work by someone else, though that protection lasts only for a limited period. Copyright is an inherent right that commences since the completion of the work as expressions of the idea. A copy right work is protected from its creation and registration is not required for a work to be protected. For a work to enjoy protection it has to be original. Copyright is not a permanent right. The law protects copyright only for a specific period and after the expiry of that period, the work passes off into the public domain. Under international convention, the period is fixed as lifetime of an author plus 50 years. Indian laws provide for a longer period of lifetime plus 60 years.

Trademarks

A trademark is a word, a logo, a number, a letter, a slogan, a sound, a colour or sometimes even a smell which identifies the services or goods of one enterprise from those of the competitors. They may consists of drawings, symbols, three dimensional signs such as shape and packaging of goods, audible signs such as music or vocal sounds, fragrances or colours used as distinguishing features. Trademarks and service mark are distinctive symbols, signs, logos that help the consumer to distinguish between competing goods or services and are a major part of the goodwill a company enjoys in the trade. Trademarks invariably can symbolize quality of goods or services in the customers mind; though there is no requirement in law that trademark has to meet any quality standards. In the language of law brand names are known as trademarks (Coca-cola and Mc Donalds).

Intellectual Property Protection of Traditional Knowledge

Most interpretation of the term 'Traditional Knowledge" (TK) incorporate "innovations and the volume of knowledge continually developed, acquired, used, practiced, transmitted and sustained by communities through generation supported by their ecology, environment, life styles, attitudes, societies and culture" (Ganguli, 2001). At many times, TK forms the basis for new scientific innovations. Hence legal framework is to be identified for the protection of traditional knowledge, which will help to nurture innovations from communities for fair competitive exploitation in

the market place. Present day IPR framework considers documented knowledge as prior art. Defining "what constitutes prior art" and establishing the "state of knowledge at any point in time, especially within the community" would be a challenge. In a move all countries belonging to the Organisation of African Unity (OAU) have formulated a model bill which states that ownership of new compounds made from natural products found in Africa "should rest with indigenous local communities for all times and in perpetuity". This draft bill has been drawn up to harmonize African Legislation on "Bioprospecting" by multinational.

In present day context of biopiracy and debatable issues, data base and community registers are crucial in protecting community rights. Some of the relevant database in this area are "Data base of Ethno pharmacology of Indian Medicinal Plants" and CSIR CDROM on Medicinal and Aromatic Plants Abstracts.

Conclusion

Most IPR laws have evolved to a reasonable extent to deal with non-living material and processes used to produce them. However the laws deciding on proprietorship and trade of knowledge related to the animate or biological matter such as gene and DNA, microbes and biodiversity are in their rudimentary phase and need further refinement (Ganguly, 2001). Even then the question of 'whether the countries in their rudimentary phases of development have the capacity and expertise to manage the complex issues related to IPR' remains.

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Management of Pest and diseases with an emphasis on global trade

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The production and management of agricultural produces and products as food, feed, drugs or for other industrial purposes like textile fibre demand international regulations, standards and obligations to be satisfied for their global as well as domestic trade affairs.

Crop protection and international trade

Consumers in the developed countries expect to choose from an abundant supply of fresh and high quality foods that meet our nutritional needs, while being affordable and accessible all year-round. As with many hallmarks of modern society, we take all of this as taken for granted. At the same time improvement of livelihoods of the farming community and the accompanying social benefits to the developing economies have to be ensured. With the growing global populations, constantly challenging food production, management of crop production and protection of produces and products offer means towards meeting the challenge of more food out of dwindling cultivable lands. Therefore, in developing countries chemical crop protection is used as a means to help farmers improve agricultural productivity, contribute to food security and alleviate poverty. Nevertheless to reap more economic benefits especially from the global trades the Indian farmers have also to satisfy the international demands of quality standards and practices in pest management aspects with chemical inputs, quarantine procedures and exim strategies.

Sanctity of crop protection

Food crops must compete with 30,000 species of weeds, 3,000 species of nematodes and 10,000 species of plant-eating insects. We know that despite the use of modern crop protection products 20-40% of potential food production is still lost every year to pests. These losses can occur while the crop is growing in the field, when it is in storage and in the home. In short, an adequate, reliable food supply cannot be guaranteed without the use of crop protection products. However

growing awareness and demand for chemical free produces out of organic farming can also be exploited for global trade by strictly observing the zero tolerance strictures in chemical residues.

Crop protection

- Chemical crop protection products or "pesticides" help control insects, diseases, weeds, fungi and other undesirable pests.
- Pesticides comprise a wide range of products for both professional and home applications including insecticides, fungicides, herbicides, sanitizers, growth regulators, rodenticides, and soil fumigants.
- The use of chemical crop protection in all contexts is highly regulated.
- The regulatory framework of pesticides encompasses national, regional, and international legislation and conventions that help assure safety for users, consumers and the environment.
- Chemical crop protection products, commonly referred to as pesticides or agrochemical products, play a vital role in controlling the pests and diseases that threaten our food supply.

Good Agricultural Practice (GAP)

Agricultural practices recommended as good for the soil water and other environmental resources as well as the personnel involved in farming activities till the final consumption of the produces and products are regarded as the GAP. Agricultural technology standardized for production of various crops and livestock have got their own merits and demerits pertaining to different situations demanding quality standards for global trades. However, pesticides, an unavoidable risk alleviating key component in production technology requires a lot of attention to bring it under good agricultural practices.

- For pesticide use, includes the nationally authorized safe uses of pesticides under actual conditions necessary for effective and reliable pest control.
- It encompasses a range of levels of pesticide applications up to the highest authorized use, applied in a manner that leaves a residue that is the smallest amount practicable.
- Authorized safe uses are determined at the national level and include nationally registered or recommended uses, which take into account public and occupational health and environmental safety considerations.
- Actual conditions include any stage in the production, storage, transport, distribution and processing of food commodities and animal feed.

FAO has defined the term of *pesticide* as:

Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

Type of Pesticide	Target Pest Group
Algicides or Algaecides	Algae
Avicides	Birds
Bactericides	Bacteria
Fungicides	Fungi and Oomycetes
Insecticides	Insects
Miticides or Acaricides	Mites
Molluscicides	Snails
Nematicides	Nematodes
Rodenticides	Rodents
Virucides	Viruses

Residues of pesticides

Any specified substances in or on food, agricultural commodities or animal feed resulting from the use of a pesticide can be considered as its residues. The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products and impurities considered to be of toxicological significance.

- The term "pesticide residue" includes residues from unknown or unavoidable sources (e.g. environmental) as well as known uses of the chemical.
- The definition of a residue for compliance with maximum residue limits (MRLs) is that combination of the pesticide and its metabolites, derivatives and related compounds to which the MRL applies.

Maximum residue level for pesticides

- It is the maximum permissible amount of residue (mg per kilogram) of a pesticide that may occur in a food or feed commodity following Good Agricultural Practice.
- The estimated maximum residue level is considered by the Joint Meeting for Pesticide Residues (JMPR) to be suitable for establishing Codex maximum residue limits (MRLs) and is considered by the Codex Committee on Pesticide Residues as the basis when recommending the Codex MRLs.

Extraneous maximum residue limit (EMRL)

- Refers to a pesticide residue or a contaminant arising from environmental sources (including former agricultural uses) other than the use of the pesticide or contaminant directly or indirectly on the commodity.
- It is the maximum concentration of a pesticide residue that is recommended by the Codex Alimentarius Commission to be legally permitted or recognized as acceptable in or on a food, agricultural commodity or animal feed. The concentration is expressed in milligrams of pesticide residue or contaminant per kilogram of the commodity.

Acceptable daily intake (ADI)

- The estimate of the amount of a chemical in food or drinking-water, expressed on a body weight basis, which can be ingested daily over a lifetime without appreciable health risk to the consumer.
- It is derived on the basis of all the known facts at the time of the evaluation.
- The ADI is expressed in milligrams of the chemical per kilogram of body weight
- (a standard adult person weighs 60 kg). It is applied to food additives, residues of pesticides and residues of veterinary drugs in food.

Theoretical maximum daily intake (TMDI)

- A prediction of the maximum daily intake of, for example, a pesticide residue, assuming that residues are present at the maximum residue levels/limits and average daily consumption of foods per person (e.g.as represented by Global Environment Monitoring System – Food Contamination Monitoring and Assessment Programme diets). TheTMDI can be calculated for the various regional or consumption cluster diets and is expressed in milligrams of residue per person

Tolerable daily intake (TDI)

- Analogous to acceptable daily intake. The term tolerable is used for agents that are not deliberately added, such as contaminants in food. Note that the Joint FAO/WHO Expert Committee on Food Additives uses the term provisional maximum tolerable daily intake.
- *Related terms: Acceptable daily intake, Health-based guidance value,*
- Provisional maximum tolerable daily intake.

Highest residue (HR)

- The highest residue level (expressed as milligrams per kilogram) in a composite sample of the edible portion of a food commodity when a pesticide has been used according to maximum Good Agricultural Practice (GAP) conditions.
- The HR is estimated as the highest of the residue values (one from each trial) from supervised trials conducted according to maximum GAP conditions and includes residue components defined by the Joint FAO/WHO Meeting on Pesticide Residues for estimation of dietary intake.

No-observed-adverse-effect level (NOAEL)

- Greatest concentration or amount of a substance, found by experiment or observation, that causes no adverse alteration of morphology, functional capacity, growth, development or lifespan of the target organism distinguishable from those observed in normal (control) organisms of the same species and strain under the same defined conditions of exposure.

No-observed-effect level (NOEL)

- Greatest concentration or amount of a substance, found by experiment or observation, that causes no alteration of morphology, functional capacity, growth, development or lifespan of the target organism distinguishable from those observed in normal (control) organisms of the same species and strain under the same defined conditions of exposure.

These toxicological parameters in the agricultural consignments for international trades have to be in compliance for better acceptance and returns in cash values.

Quarantine regulations and Phyto sanitary certifications

The aim of international plant protection is to limit the spread of pests and pathogens to different countries and to prevent development of epidemics and pandemic outbreaks of pestilence For this purpose, it is necessary to exchange all

information with respect to the movement of the commodities from country to country by proper monitoring, certification and enforcement of quarantine regulations by all the countries. For this purpose, it is mandatory to:

1) Organize survey and surveillance in a number of locations and exchange information in respect of occurrence and distribution of pests, pathogens, weeds etc.,

2) Regular exchange of information regarding control measures including the distribution of resistant varieties or resistant lines for breeding; and

3) Cooperation and joint efforts in enforcing regulations involving quarantine measures both at the domestic and international levels.

International quarantine regulations which aim to prevent entry of new pathogens and pests may;

a) Completely prohibit entry of certain plants or plant materials;

b) Allow export of certain plants and plant materials if they are certified to be free from certain specific pests and pathogenic organisms, by a competent authority of the country of origin or export (Phyto sanitary certification); and

c) Allow import or entry of plants and plant materials provided they are accompanied by certificates of freedom from pests and diseases by the competent authority of the country of origin.

The importing countries may also impose restrictions on the mode of transport (air, ship or postal mail), and wrapping materials (soils, etc.,).They also have the right to examine the materials before they can be allowed to be introduces, even if accompanied by the Phytosanitary certification from the country of origin. If needed disinfection or disinfestations by fumigation or any other treatment may also be enforced. For this purpose, the channels of entry or ports of entry may also be specified and notified.

The enforcement of legislative measures to check the entry of destructive diseases and pests from other countries can be successfully done through the cooperation of Governments of different countries. Accordingly, the FAO has set up the International Plant Protection Convention of 1951 in which the different countries are signatories. They are expected to respect the provisions of Quarantine Laws or Acts of different countries.

These are some of the concerns of the pest management issues on a global basis for international trade and relationship which have to be addressed properly to harness the economic benefits to the farming communities of the developing countries .

The Agreement on Application of Sanitary and Phytosanitary Measures with Special Reference to Trade in Agriculture

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All countries enact legislations and maintain various measures to protect the human health from unsafe food and prevent the spread of pests and diseases among animals and plants. The Agreement on Application of Sanitary and Phytosanitary Measures (the SPS Agreement) of WTO is the International Agreement which is concerned with the issues of food safety and health of animals, plants and the environment. The measures stipulated in the SPS Agreement are equally applied to both domestically produced and imported food products. The stringent international standards that are being enforced by the developed countries consequent to the implementation of the SPS Agreement are becoming a major non-tariff barrier to the exports from India and other developing countries. The Scope of the SPS Agreement covers all sanitary (human and animal health) and phytosanitary (plant health) measures which may directly or indirectly affect international trade. For the purpose of SPS Agreement, sanitary and phytosanitary measures are defined as any measures applied to protect from risks arising out of additives, contaminants, toxins or disease causing organisms in human and animal food, plant or animal carried diseases, pests, diseases or animal carried pests, diseases or organisms and entry, establishment or spread of diseases into the country. The Agreement covers all relevant laws, decrees, regulations, testing, inspection, certification and approval procedures and packaging and labelling requirements directly related to food safety. The SPS measures also include sanitary and phytosanitary measures taken to protect the health of fish, wild fauna as well as forests and wild flora. Members can also take measures necessary for protecting human life from harmful organisms in food beverages and feed being given to cattle and residues of pesticides, antibiotics, heavy metals, etc.

The SPS Agreement was signed during the Uruguay Round of WTO. SPS Agreement is a spin off from the Agreement on Technical Barriers to Trade (TBT Agreement) which was signed and negotiated during the Tokyo Round (1973-

1979) of multilateral negotiations. The Agreement on Agriculture, another important WTO Agreement clearly endorses the implementation of SPS Agreement through its Article 14 which states that the "Members Agree to give effect to the Application of Sanitary and Phytosanitary Measures". The right of Governments to restrict trade when necessary to protect human, animal or plant life and health was also recognized under the GATT [In Article XX(b)]. The SPS Agreement contains 14 Articles and three Annexes covering basic rights and obligations, harmonization, equivalency, risk assessments, pests or disease free areas, transparency, control, inspection and approval procedures, technical assistance, special and differential treatment for development countries, consultations and dispute settlement, administration and implementation.

The basic purpose of the SPS Agreement is to safeguard the health of plants, animals and humans against any infection or disease causing agents coming into any country with the food products being imported from the rest of the World. This Agreement only specifies the minimum standards and methodology for determining these. Based on the guidelines, the actual standards to be followed are determined independently by the member countries (Chakraborty and Khan, 2008). The Agreement allows member countries to set their own standards. However, these regulations must be based on scientific evidence. SPS Measures should be applied only to the extent necessary for protecting human, animal or plant life or health. Member countries of WTO are encouraged to use international standards and recommendations wherever they exist. . However members can use a standard higher than the international standard, if they can provide scientific justification.

The stringent standards set by some of the developed countries consequent to the implementation of SPS Agreement are fast becoming a major non-tariff trade barrier (NTB) to exports from developing countries. Many of the developing countries and their small or medium sized food production and processing units do not have the infrastructure or institutional facilities for conforming to the high standards set by agencies in developed countries. Difficulties also arise as a result of varying standards insisted by different countries. Standards are sometimes kept strategically high by the developed countries for preventing exports from developing countries, thereby creating some form of disguised trade barriers against them. Ganslandt and Markusen (2001) have shown that higher standards imposed by the developed countries always result in profitability by domestic firms, but the reduction of the same in the developing countries.

Major Provisions of SPS Agreement

Scientific Justification and Non-discrimination

Members shall ensure that any sanitary or phytosanitary measure is applied only to the extent necessary to protect human, animal or plant life or health based

on scientific principles and is not maintained without sufficient scientific evidence except as provided in Article 5.7 (Article 2.2). Members shall also ensure that their sanitary and phytosanitary measures do not arbitrarily or unjustifiably discriminate between members where identical or similar conditions prevail including between their own territory and that of other members (Article 2.3).

Harmonization based on international standards

To harmonize sanitary and phytosanitary measures, on as wide a basis as possible, members shall base their sanitary and phytosanitary measures on international standards, guidelines or recommendations where they exist (Harmonization – Article 3.1). SPS measures that conform to international standards, guidelines as recommended above shall be deemed to be necessary to protect human, animal or plant life or health (Article 3.2).Thus the standards set by international agencies in the concerned fields will be the minimum standards required to be followed by any member country of WTO. In the case of food safety, the member countries have to harmonize their law with the standards, guidelines, and recommendations established by the Codex Alimentarius Commission relating to food additives, veterinary drugs and pesticide residues, contaminants, methods of analysis and sampling and codes and guidelines of hygienic practice. The Codex Alimentarius Commission, of a joint FAO/WHO Commission has developed the Codex Alimentarius, a collection of international food standards for all principal food products. The Codex Alimentarius includes more than 5000 standards aimed at protecting the health of humans and also ensuring fair practices in international food trade.

The agency responsible for the development of international standards for trade in animal and animal products is the International Office of the Epizootics (OIE) based in Paris. In the field of plant health, the standards, guidelines and recommendations developed under the auspices of the Secretariat of International Plant Protection Convention (IPPC) of FAO are recognized as relevant international standards. IPPC sets International Standards for Phytosanitary Measures (ISPMS). For areas not covered by these organizations, the SPS Committee recognizes standards developed by other relevant international organizations. Sanitary or Phytosanitary measures which conform to international standards, guidelines or recommendations shall be deemed to be necessary to protect human, animal or plant life or health (Article 3.2).

Option for setting higher standards

Members may introduce or maintain sanitary or phytosanitary measures which result in a higher level of protection than would be achieved by measures based on the relevant international standards provided there is scientific justification (Article 3.3) or as a consequence of the level of sanitary or phytosanitary measure a member

decides to be appropriate as determined by assessment of risk as per the relevant provisions of paragraphs one through 8 of Article 5(2).

Concept of Equivalence

Article 4 of the SPS Agreement allows members to accept the sanitary and phytosanitary measures of other members as equivalent even if they differ from their own or from those used by other members trading in the same product. The exporting member should objectively demonstrate to the importing member that its measures achieve the importing members appropriate level of sanitary and phytosanitary protection (ALOP). Equivalence is an ideal option when international standards are lacking or are not suitable for application in the relevant case. Article 4.2 encourages member countries to develop Mutual Recognition Agreements (MRAS). The MRAS could either be limited to purposes like the testing methods, or they can cover all aspects including the standards.

Risk Assessment (Article 5)

The sanitary and phytosanitary measures of members shall be based on an assessment as appropriate to the circumstances of the risks to human, animal or plant health, taking into account risk assessment techniques developed by relevant international organizations. Factors such as available scientific evidences, processes and production methods, inspection and sampling methods, prevalence of specified diseases or pests, existence of pest and disease free areas, quarantine or other treatment should be taken into consideration while assessing the risk. While determining appropriate level of protection, the objective should be to minimize negative trade effects. Arbitrary or unjustifiable distinctions in the levels in different standards should be avoided if these result in disguised restrictions.

Precautionary Measures (Article 5.7)

Members are allowed to adopt provisional SPS measures when relevant scientific information is in sufficient on the basis of available pertinent information. In such cases members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the SPS measures accordingly within a reasonable period of time.

Pest and Disease Free Areas (Article 6)

Members shall recognize the concept of pest or disease free areas and areas of low pest and disease prevalence. Such areas shall be declared on the basis of factors such as geography, ecosystems, epidemological surveillance and the effectiveness of sanitary or phytosanitary controls. Exporting countries claiming pest or disease free areas in their territory shall provide the necessary evidence thereof in order to objectively demonstrate to the importing member that such areas are likely to remain pest and disease free areas.

Transparency through notifications (Article 7 and Annex B)

Governments are required to notify other countries of any new or changed sanitary or phytosanitary requirements which affect trade and to set up offices called enquiry points and to respond to requests for more information on new or existing measures. Notifications are to be issued in the event of non-existence of an international standard or where substantially different from international standards or where the regulation may have a significant effect on trade. The procedure for notification is provided in the Annex B of the SPS Agreement.

Except in urgent circumstances, members shall allow a reasonable interval between the publication of the SPS measure and its entry in to force in order to allow time for producers in exporting countries to adopt their products and methods of production to the requirements of the importing countries. However, where urgent problems of health protection arise or threaten to arise for a member, that member may omit the steps for notification and immediately notify the measures that are going to be adopted through WTO Secretariat. This notification should give the details of particular regulation and the products covered with a brief indication of the objective and rationale of the regulation and the nature of the problem.

Technical assistance/Special treatment to developing countries (Article 9 & 10)

Members shall provide technical assistance to other Members, especially developing country Members, either bilaterally or through appropriate international organizations. The areas of technical assistance include processing technologies, research and infrastructure and establishment of regulatory bodies. Technical assistance may be in the form of advice, credits, donation, grants, training or equipment.

Members shall take into consideration the special needs of the developing countries while developing SPS measures. Larger time frames should be allowed to developing countries for complying with measures for products of special interest to the developing countries. Specific and time limited exception shall be granted by SPS committee to the developing countries for complying with the obligations of the Agreement on specific requests taking in to account their financial, trade and development needs.

Dispute Settlement and Administration

The provisions of Articles XXII and XXIII & GATT 1994 as elaborated and applied by the Dispute Settlement Understanding shall be applied to the consultations and the settlement of disputes under the SPS Agreement (Article 11).

The implementation of the provisions of the SPS Agreement will be monitored by the committee on Sanitary and Phytosanitary Measures (Article 12).

SPS Agreement and Agricultural Trade

High levels of Sanitary and Phytosanitary Measures maintained by developed countries can act as an impediment against the imports from the developing countries in the form of costly and time consuming tests. It may be difficult for the small and medium scale enterprises in developing countries to comply with the standards set by developed countries which are higher than the standards recommended by the international standard setting agencies. Agricultural products, especially processed food products are most vulnerable to these Non-Tariff Barriers (NTBs). These high standards have often been a discord between trading nations. The exporting countries allege that these standards are set at unreasonably high levels. They also contend that the purpose is not just to ensure health safety, but there is hidden agenda of using them as trade barriers against exporting countries. It is felt by the developing countries that unreasonably highs standards which are difficult to meet would reduce their export opportunities by blocking access to some of the markets and this would hamper their growth (Chakraborty and Khan, 2008).

The SPS issues are becoming more important in the international trade of agricultural products as tariff barriers are falling as a result of the implementation of Agreement on Agriculture. Food producers in developing countries are becoming increasingly concerned that the growth of their export markets is being hampered by SPS measures. The interest of developed countries is not to ensure the safety of consumers but to protect their domestic markets. Generally these measures are imposed in the form of end product related standards, production process standards, testing procedure standards and certification procedures. In major importing countries, marine products and fruits exported from India are mostly affected by the Non-Tariff Measures in the form of SPS measures. Single product faces a number of SPS standards in the same market

End Product Related Standards

End product related standards are restrictions imposed on the quality of a product. A simple product may face different import standards in different markets. The EU Commission in Brussels has specified the tolerance level and testing procedure for the presence of Afflatoxin in groundnut. The new levels are extremely low and the procedures are more stringent than the previous ones. These standards are higher than the international standards stipulated by the Codex. Even within the EU member states maximum levels of afflatoxin content in a product varies. In Belgium, the approved maximum level of afflatoxin is 0 and in Germany less than 4 ppb in Netherlands and Spain less than 5 ppb.

Production processes

The EU countries lay a lot of emphasis on the production processes and methods of the goods and not only on the end product. Many a times, they demand

that proper conditions are maintained even when the goods are produced and not just during the processing. An example of process standard is the restriction imposed by EU that only milk that has been mechanically milked from cows can be imported to EU and the cows should be kept in farms (Directive 92/46 EEC).

Testing procedure standards

Detailed and extensive tests are to be conducted on food products before they are exported to foreign destinations. The testing procedures as well as the kind of adulteration being tested for vary from one agency to other.

Certification

The developed countries often demand that certain international standards should be complied with while certifying the products. Sometimes they demand certification from independent agencies. Certification and import procedures also vary from country to country. China insist that a new and original phytosanitary certificate must be accompanied with each consignment of fresh fruits, vegetables or tree nuts. Many countries including the US, EU, China and Japan also insist on strict packaging and labelling requirements.

Some Case Studies on SPS Measures

The US-Japan Apple Fire Blight Case

Fire blight disease caused by the bacteria *Erwinia amylovora* can damage apple trees and cause infected fruits to shrivel and turn brown. The disease exists in some parts of the United States, but does not exists in Japan. Japan introduced a number of SPS measures restricting apple imports from other countries. The restriction include the requirement that fruits come from designated orchards free from fire blight and that no other fire blight host plants exist in the designated orchards. Orchards should be surrounded by a buffer zone free of fire blight and the orchards and buffer zones should be inspected at least three times each year. The harvested fruits should be subjected to surface chlorine wash and the containers for harvesting and the interior of the packing facilities should be subjected to chlorine treatment. The SPS measures also stipulate that apples designated for Japan should be kept separate from other apples and the US officials should certify that the fruits have been treated as required. The Japanese officials should confirm the certification and inspect the facilities. Japan claimed that all these measures were necessary for an integrated approach for avoiding the entry of fire blight disease into Japan, which has a fire blight susceptible environment.

Following a complaint by the US, the WTO Dispute Settlement Body established a panel in June 2002. The panel concluded that the SPS measures adopted by Japan were against Article 2.2 of SPS Agreement. There was no conclusive evidence

that fresh apple fruit could serve as a pathway for spread of fire flight disease and the disease has ever been spread through trade in apples. Japan argued that its measure should be considered as a provisional measure as permitted by Article 5.7. The panel found that given the extensive amount of scientific evidence available regarding the fire blight disease and its measure, this was not a situation in which Article 5.7 could be invoked.

Japan conducted two risk assessments regarding fire blight disease in 1996 and 1999 on apples imported from US. The 1999 risk assessment was considered as the relevant risk assessment for the purpose of the dispute. The panel found, however, that the 1999 pest risk assessment did not meet the requirements of a risk assessment within the meaning of Article 5.1. It failed to evaluate the likelihood of entry, establishment or spread of fire blight through the importation of apple fruit, and further more, did not evaluate the risk according to the phytosanitary measures which might be applied. The Appellate Body upheld the findings of the panel that the SPS measures of Japan were inconsistent with the provisions of Article 2.2, 5.7 and 5.1 of SPS Agreement.

Japan was requested to modify its SPS measures regarding fire blight disease of apple before June 30, 2004. Japan and United States notified that they had reached a mutually agreed solution on 2 September, 2005.

EU-US Biotech Products Dispute

In 2003, the USA challenged a number of EU laws restricting the importation of biotech products. On August 7, 2003, the Unites States requested for establishing a dispute settlement panel under the provisions of WTO against certain measures taken by EU and its Member States affecting import of agricultural and food imports from United States. The US asserted that the moratorium applied by EC since October 1998 on the approval of biotech products has restricted imports of agricultural and food products from the US. At the Member State level measures, the US complained that a number of EC Member States maintain national and import bans on biotech products eventhough those products have already been approved by the EC for import and marketing in the EC. The US complained that the EC defacto moratorium on biotech products is inconsistent with the EC's obligations under Article 2, 5, 7 and 8 and Annexes B and C of the SPS Agreement. On August 23, 2003, the DSB established a panel for examining the entire issue.

On September 26, the panel reports were submitted to the members. The DSB based on the panel reports ruled that the EU policy of defacto moratorium to the biotech products between 1998 and 2003 was inconsistent with the obligations under annexe C(i)a, the first Clause and Article 8 of the SPS Agreement because de facto moratorium led to unnecessary delays on the completion of EC approval procedure.

Regarding the bans of biotech products at the level of Member States of EU, the panel felt that sufficient scientific evidence (Article 2.2) was available to carry out risk assessment. The panel therefore rejected the EU's defence of the ban as a precautionary measure under Article 5.1 of SPS Agreement which allows WTO Members to provisionally adopt SPS measures in the absence of sufficient scientific evidence. The report called on the EU to bring the measures in conformity with the SPS Agreement which would imply revoking them or providing an SPS Agreement compliant risk assessment to justify the measures.

The US-EU Beef Hormone Case

The European Community (EC) adopted a set of council directives in 1989, that resulted in the prohibition of importation and marketing of meat and meat products treated with any of the six hormones used for growth purpose. In 1996, in their complaint to the dispute settlement body, first the US and then Canada argued that the prohibition violated SPS Agreement Articles 2, 3.1 and 5. The EU allows natural hormones for therapeutic purposes prohibiting imports of animals and meat from animals treated with hormones. The US complained that they incurred a loss of $ 100 million annually due to the ban of EC.

The hormones banned by EU in cattle farming were estradol, progesterone, testosterone, melengesterol acetate, trenbolone acetate and zeranol. Of these, the first three were artificial versions of endogenous hormones that are naturally produced in humans and animals and also occurs in a wide range of foods. The second three hormones are exogenous hormones, that is synthetic hormones that mimic the behaviour of endogenous hormones. The ban by EC was based on claim that hormone treated meat may be carcinogenic in nature.

According to Codex, these six hormones when used according to sound veterinary practices for purposes of growth do not pose risks to human health. The US complained that the EU measure is not based on risk assessment as stipulated under the relevant provisions of paragraphs one through 8 of Article 5.

After the Dispute Settlement Body process, the Appellate Body of the WTO released its report on January 16, 1998. While the Appellate Body's decision rejected a number of arguments put forward by the panels, it affirmed the panels conclusions that the EU's beef hormone policy violated Article 3.3 of SPS Agreement as it was not based on a risk assessment. Members are permitted to maintain standards higher than international standards but such measures should be based on risk assessment as provided in Article 5 of SPS Agreement. The Appellate Body ruled against the ban of importation and marketing of hormone treated beef and gave EC a reasonable period of 15 months to remove the ban. However, the EC failed to remove the ban. Subsequently the US went before the DSB claiming that the non-removal of the ban had affected its exports of meat products and that there was a

nullification and impairment (N and 1) of an amount equaling to $ 202 million per year. Despite the ongoing series of dispute settlement proceedings and decisions by WTO, there is continuous disagreement among the US and EU over a range of legal and procedural issues as well as scientific evidence and consensus on safety of hormone treated beef (Johnson and Hanrahan, 2010).

Japan-varietals or the Codling Moth Case

Japan wanted to avoid the introduction of Codling Moth (*Cydia pomonela*), considered to be a pest and thereby protect its plants, by restricting certain fruit imports from the United States. The dispute was over Japan's procedure of testing each variety of fruit imports from the US for the presence of a codling moth. The imports affected were fruits such as apples, cherries, plums, pears, etc. all prime targets of Codling moth larvae.

Japan insisted for quarantine treatment for each subsequent fruit variety, not withstanding the fact that earlier varieties of the same fruit had been cleared for entry in to Japan. The US complained that testing of each variety was time consuming and against the provisions of the Agreement on SPS Measures. The US contended that, if the testing requirement had been found efficient on a single variety of a fruit, it would be true for all other varieties of the same fruit. The varietal testing measure according to the US was not in conformity with Article 2.2, 5.1, 5.2, 5.6, 5.7, Article 7 and Annex B.

The varietal testing requirement for subsequent varieties of the same fruit, according to the US was against the SPS Agreement and exporter interests on account of time consuming procedures. The Appellate Body after examining the panel reports, ruled on February 22, 1999 that Japan should bring its varietal testing procedure in conformity with the WTO Agreement. The Appellate Body ruled that any SPS measure should be based on scientific evidence (Article 5.2), not trade restrictive (Article 5.6) and be transparent in implementation (Article 7 and Annex B).

Australian Salmon Case

Import of Pacific Salmon from any other country was restricted under the Australia's Quarantine Proclamation No. 864 of 19th February 1975. Australia published the final version of the Australian Salmon Import Risk Analysis in 1996. According to this final report, Australia prohibited the imports of fresh, chilled or frozen adult, wild, ocean caught Pacific Salmon (uncooked salmon) from other countries. However, Australia allowed imports of Salmon products if they went through a process of heat treatment at a temperature of 35 degrees centrigrade and for a period of not less than seven hours. The measure was aimed at preventing the spread of diseases among salmon fish population in Australia. As a consequence, imports of Salmon were limited to smoked and canned salmon.

In 1997, Canada filed a complaint before the DSB of WTO against the import restrictions on Salmon fish maintained by Australia. In their complaint Canada pointed out that Australia allowed imports of live ornamental fish and Herring in whole, frozen form that was used as a bait even if these products were also known to be hoists of harmful disease agents. This dual import policy was against provisions of SPS Agreement.

The import ban of Australia was based on the concern that import of uncooked Salmon would result in entry, establishment or spread of any of the 24 diseases identified as having potential to cause adverse economic and environmental consequences for Australia. Among the 24 diseases mentioned by Australia, two found place in the International Office of Epizootic's (OIE) list of Notifiable Diseases and four diseases in the list of other diseases. Notifiable diseases are those diseases that are generally regarded as having serious damage to the national aquacultural industries or wild population of fish.

Canada argued that chances of introduction of the diseases were negligible if the imports were restricted to headless, eviscerated (disembowelled) salmon instead of heat treatment. Moreover, there was no knowledge of any published information on such treatments (heating and disinfection) reducing the risk with regard to entry, establishment or spread of 13 of the identified 24 diseases. Canadian submission also pointed out the thermal stability of a number of pathogens of high quarantine importance at lower temperature ranges.

The Appellate body concluded that Australia should bring its measures in conformity with Article 5.1 and 5.5 of the SPS Agreement. The dispute went before an Arbitrator and the Arbitrator allowed a 'reasonable time' of eight months from the date of adoption of the panel reports ie; from November 16, 1998 to Australia for making its SPS measures consistent with the provisions of the Agreement on SPS Measures.

Some of the new issues in SPS Measures

Private Standards

The SPS measures are generally those measures set by the international standard setting bodies or those imposed by the national governments. Some developing countries have started to raise the issue of standards set by the private sector especially the standards set by multinational supermarket chains. This issue was first raised in June 2005 by Saint Vincent and Grenadines on private standards on banana which are more stringent than the international standards causing small farmers to suffer. Private standards often conflict with international standards or those set by national governments.

Transparency

Eventhough over 10000 food safety, plant and animal health standards have been notified bill October 31, 2011, not all countries are providing advanced warning about changes in SPS Measures. Complaints about insufficient transparency are common.

GM Pollens in Honey

The European Court of Justice recently ruled that pollen found in honey should be considered an ingredient rather than a natural constituent. This means that pollen from genetically modified GM plants would have to be approved as ingredients for honey sold in Europe. The Codex does not treat pollen as an ingredient of honey. The US, Canada, Argentina, Brazil and Canada complain that this has created uncertainty and caused EU honey imports to fall.

India's Measures against bird flu (avian influenza)

The US and EU continuously call for scraping India's import restrictions on pork on grounds that the risk assessment that India gave to them is sufficiently inadequate. Neither science nor international standards justify such measures since pigs do not transmit the virus. India argues that its risk assessment has not been completed and some scientific research shows the virus can be carried by pigs.

Special Treatment to Developing Countries

Developing countries are asked to adopt higher SPS measures with out providing adequate time or technical assistance for implementing these measures. An example is recent US Food Safety Modernization Act.

Conclusion

There is a conflict between developed and developing countries in the implementation of Agreement on Application of SPS Measures since it is difficult to differentiate between those measures which are justified by food safety and animal and plant health concerns and from those which are applied as disguised trade barriers. The disputes over SPS measures always involve issues of science, technology, law and domestic and international trade. Differences between measures adopted on the basis of sound scientific evidence and measures adopted on the basis of precautionary principles are also creating tensions between countries. There is a growing need for developing countries like India to scientifically respond to the SPS issues in their major export markets by providing safe and high quality agricultural products. There should be concerted effort to build up and modernize scientific knowledge, skills and capabilities in this field.

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MANAGEMENT OF SOIL AND NUTRIENT RELATED CONSTRAINTS OF FARMING IN KERALA

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Lateritic soil is the important soil type of Kerala. Laterites are also mostly seen in Karnataka, Summits of Deccan, Eastern Ghats and West Maharashtra and central part of Orissa and Assam. In Kerala, 68% of cultivated land is having lateritic soil. Low nutrient use efficiency, poor productivity and wide gap between realizable and realized yield are the major limitations of this soil.

Being in the humid tropics they are susceptible to high level erosion. In general, laterites are uplands which support a variety of crops which are tolerant to high soil acidity and high exchangeable aluminum. Lateritic alluvium is formed in river valleys and river mouths in the lowland, where rice is the main crop.

Constraints of crop production in lateritic soil

The important physical constraints are soil erosion, hardening of laterite at surface, low water holding capacity and drought stress. High soil acidity and high exchangeable aluminium, low cation exchange capacity and high anion exchange capacity, deficiency of calcium, magnesium, sulphur, zinc, copper, boron and molybdenum, toxicity of aluminium and manganese in uplands, toxicity of iron, manganese and aluminium in lowlands and high phosphorus fixation are the important chemical constraints.

Researches conducted under diverse conditions and in several crops clearly revealed that these constraints can be eliminated by adopting appropriate technologies and achieve higher productivity. Several of the essential micro nutrients are well above the critical level required for successful crop production (Table 1) which may negatively influence the plant physiological processes. However the organic matter content and the primary and secondary nutrients are well below the required limit. Thus, in lateritic soil the 'law of minimum' as well as the 'excesses of native nutrient elements' equally operates in yield determination processes. The use efficiency of applied major nutrients - let it be agronomic efficiency, uptake

Table 1. Critical and available levels of micro nutrients in lateritic soil of Kerala

Element	Critical Level (mg/kg)	Available (mg/kg)	
		Range	Mean
Zn	0.2 – 2.00	0.0 – 22.2	(2.50)
Cu	0.1 – 0.25	0.0 – 11.30	(1.40)
Fe	2.5 – 5.00	2.1 – 266	(70.30)
Mn	1.0 – 5.00	0.8 – 155	(25.00)
B	0.1 – 0.20	0.0 – 6.8	(0.80)
Mo	0.1 – 0.30	0.01 – 0.25	(0.03)

(Susan, 2010)

efficiency, physiological efficiency or partial factor productivity - are negatively influenced particularly by the excesses of iron, manganese and aluminium.

Managing constraints

Strategies were evolved to contain physical and chemical constraints and to maximize crop productivity in laterites. Crop improvement, integration of biological and cultural management, regulation of nutrient supply, use of soil amendments etc. are employed to eliminate the constraints.

Crop and varietal selection

A natural selection of crops which tolerate very high level of exchangeable aluminium and low pH is already exist in the lateritic belt. Rubber, tea, pine-apple, cashew, cassava, coconut, coffee, rice etc are a few important ones. Large scale biodiversity is also there in rice and cassava. Breeders have considered it as a priority to evolve varieties with high productivity specifically suited to tolerate adverse properties of the lateritic soil.

Cultural management

Maintenance of ground cover, mulching, green manuring, inter cropping and multiple cropping systems, techniques for checking erosion, soil compaction and leaching hazards are more practical ways to sustain or improve the crop production capacity of lateritic soil.

Nutritional management

Integrating sources of nutrients - organics, inorganics and biofertilizers - in a well managed soil with appropriate tillage and addition of amendments can create specific external nutritional environment required for crops.

Use of organics and bio-fertilizers

Organic manure application to the extent of 5 to 50 t/ha is recommended for the lateritic soils of Kerala which vary with crops. In rice, the organic manure isr recommended to apply 5 to 10 t/ha to maintain the soil organic carbon status as well as to improve the use efficiency of the applied fertilizers, whereas for the crop Amaranthus the organic manure recommendation is 50 t/ha. Use of bio-fertilizers such as *Rhizobium, Azospirillum* and *Acetobactor* and Phosphorus Solubilizing Bacteria (PSB) are recommended. The crop response to the applied phosphorus is relatively lower in lateritic soil, much less than that of nitrogen, sometimes even less than potassium and sulphur. Several studies have shown that the increased availability of native phosphorus in reduced condition in rice soils (Ittyavirah *et al*, 1979) phosphorus fixation of the available P in upland soils (Anilkumar, 1999) anionic competition (Bridgit, 1999) as the reasons for reduced P response. Continued application of PSB in lateritic soil is found to enhance the available P status and P uptake by crops (Table 2).

Table 2. Soil available P and nutrient uptake by a cow pea crop as influenced by P sources with or without PSB

Treatment	Available P* (kg/ha)		P uptake (kg/ha)	
	After 1st crop	After 2nd crop	After 1st crop	After 2nd crop
No P	18.8	17.6	3.4	3.6
Rock phosphate	17.5	18.6	3.5	3.8
SSP	18.6	19.1	3.8	4.0
PSB alone	20.6	22.6	3.8	4.2
Rock phosphate + PSB	21.4	24.3	3.9	4.4
SSP + PSB	22.6	25.8	4.0	4.8

* Initial status is 18.2 kg/ha, P_2O_5 applied at 30 kg/ha (RRS, 1998)

Accelerated organic matter decomposition in the humid tropics and subsequent loss is a burning problem in the lateritic soil. Recommended quantity of organic manure is not supplied at several instances due to unavailability and other practical problems. Recently, the use of combine harvesters in rice has spread rapidly and the entire straw is left unused in the field and can be a source of organics.

Though the initial growth and dry matter production in the straw incorporated field is relatively less in the straw incorporated plots, the final yield was more than no-organic manure application or even cow dung application at 10 t/ha (Table 3). Soil analyses data revealed 20 to 30 kg of soil N immobilization during the early phase of rice growth. Further research reveled that 20 to 30 kg of N applied together with the ploughing in of the rice straw can compensate the immobilized N and result in enhanced growth and yield, and this has become a recommendation for package of practices to the farmers.

Table 3. Dry matter production (kg/ha) of rice as influenced by straw incorporation

Treatment	Dry matter production (kg/ha)				
	Tillering stage	PI stage	Harvesting stage		
			Straw	Grain	Total
No organics	4150	6979	5769	5278	11047
Straw incorporation	3840	7503	6731	5732	12463
Cow dung	4222	8306	6208	5441	11649

(Rathish, 2010)

Regulated use of chemical fertilizers

The nutritional management is based on the facts revealed by a series of experimentation, both location and crop based. The net effect concept, formulated based on such information, that the realized yield at any instance is not the resultant of the applied major elements alone but is the net product of interaction of applied as well as non-applied elements. Native non-applied elements absorbed by the plants though are essential exceeds the level of actual metabolic requirement and turn harmful to growth and may be capable of even suppressing the positive effects of applied elements. Neither the level of application of nutrients nor the uptake per se decide the yield, but is a specific combination brought about that deciding the yield. The practical advantage of the net effect concept is that low yields are not due to inadequacy of the nutrient input and regulatory management shall further boost the yield. Such a regulatory management was experimented in banana were the NPK fertilizers were applied through drip fertigation (both surface drip and sub-surface drip). In the first year higher dose of 400:230:600 g NPK / plant was given through 12 liters of water per day. Whereas, in the second year 200:150:300 g of NPK was given through 28 liter per day per plant. The higher dilution of the fertilizer solution dripped in the root zone positively influenced the soil pH in the rhizosphere and consequently influenced the solubility, release and uptake of native non-applied elements (Tables 4a, b & c).

Table 4. Range and mean yield of foliar nutrient content at critical flower initiation, total uptake and physiological efficiency.

(a) Nutrient content and yield

Nutrient	First year		Second year	
	Range	Mean	Range	Mean
N (%)	2.90-3.58	3.28	3.06-4.48	3.83
P (%)	0.14-0.36	0.25	0.12-0.26	0.21
K (%)	4.0-5.3	4.37	4.6-6.1	5.23
Ca (%)	0.41-1.16	0.77	0.2-0.44	0.31
Mg (%)	0.31-0.67	0.47	0.21-0.37	0.26
Fe (ppm)	217-441	331	150-309	237
Mn (ppm)	1200-2100	1649	630-1750	955
Cu (ppm)	10-12.3	10.7	8.3-12.0	10.7
Zn (ppm)	14-28	17	13.0-17.3	15.0
Yield (Kg/plant)	4.3-7.2	5.82	7.7-12.27	9.92

(Deepa *et al*, 2001)

(b) Total uptake (g / plant) and yield (kg / plant)

Nutrient	First year		Second year	
	Range	Mean	Range	Mean
N (%)	44.3-80.0	62.4	41.26-86.9	68.4
P (%)	3.06-8.59	4.76	2.58-6.46	5.14
K (%)	178.2-417.3	299.7	207.4-514.2	355.9
Ca (%)	23.45-43.5	32.2	19.37-40.79	31.71
Mg (%)	14.3-24.9	18.4	7.28-15.02	11.74
Fe (ppm)	3.77-6.28	5.3	1.97-5.23	3.38
Mn (ppm)	4.69-8.64	6.12	3.4-9.24	6.05
Cu (ppm)	0.04-1.2	0.07	0.03-0.08	0.055
Zn (ppm)	0.09-0.14	0.11	0.07-0.17	0.124
Yield (Kg/plant)	4.3-7.2	5.82	7.7-12.27	9.92

(Deepa *et al*, 2001)

(c) Physiological efficiency (g of fruit / g of nutrient uptake)

Nutrient	First year		Second year	
	Range	Mean	Range	Mean
N (%)	67-123	93	126-193	170
P (%)	619-1609	1223	1571-3070	1929
K (%)	16.5-26.2	19.4	17.4-38.2	27.8
Ca (%)	134.8-245.4	180.5	245-429	313
Mg (%)	163-465	392	675-1088	845
Fe (ppm)	751-1606	1098	1896-5304	2933
Mn (ppm)	616-1139	951	1020-2373	1639
Cu (ppm)	52000-123400	83142	119367-242812	180363
Zn (ppm)	36944-77419	53394	53592-116063	80000

(Deepa *et al*, 2001)

The higher yield in the second year was associated with the increase in the foliar content of N and K during the 4th month (critical period of flower initiation) and to a decline in the content of all elements including the native non-applied elements absorbed by the plants. The increase in physiological efficiency with variable changes in concentration and uptake of elements coupled with the observation that uptake did not corresponds to level of application is sufficient proof to the contention that neither levels of application nor uptake *per se* decide the yield, but it is the specific combination brought about to decide the yield.

Use efficiency of the nutrients

The agronomic efficiency of primary nutrients is relatively low in lateritic soil. The research results indicated that in lateritic alluvium the AE of nitrogen is 10 to 20, that of P is 8 to 15 and that of K is 10 to 15 under the usual recommended dose of 90:45:45 kg of NPK / ha for rice, varying with different management,

Tables 5a, 5b, 6a and 6b show the improvement in the efficiency parameters of the applied nitrogen due to the application of lime, which acted both as a source of calcium and as an amendment for soil pH, and sulphur which is established to be a yield limiting secondary nutrient in lateritic soil. Significant sulphur nitrogen interactions were reported for several crops with regard to the yield and use efficiency parameters.

Micronutrient fertilization

The micro nutrients such as zinc, boron, copper and molybdenum are reported to be deficient in several occasions and affect the productivity of several crops and appropriate recommendations are evolved for inclusion of these nutrients in the

Table 5 a. Yield, N content and uptake as influenced by liming in rice

Treatment		Yield (t/ha)		N content (%)		Uptake (kg/ha)		
		Grain	Straw	Grain	Straw	Grain	Straw	Total
-lime	N_0	3.70	3.50	1.15	0.52	42.5	18.2	60.7
	N_{90}	4.60	4.70	1.25	0.56	57.5	26.3	83.8
+lime	N_0	4.20	4.40	1.18	0.55	49.5	24.2	73.7
	N_{90}	5.40	5.50	1.30	0.58	70.2	31.9	102.1

(John *et al*, 2004)

Table 5b. N use efficiency as influenced by liming in rice

Treatment	Agronomic efficiency	Uptake efficiency	Physiological efficiency	Partial factor productivity
-lime	10.0	0.26	38.9	51
+lime	13.3	0.28	42.3	60

(John *et al*, 2004)

Table 6a. Response of rice to N & S fertilization under liming

Treatment			Yield (t/ha)		N content (%)		N uptake (kg/ha)		
			Grain	Straw	Grain	Straw	Grain	Straw	Total
- lime	N_0	S_0	3.9	3.8	1.07	0.51	41.73	19.28	61.11
	N_0	S_{15}	4.3	4.4	1.12	0.52	48.16	22.88	71.04
	N_{90}	S_0	4.9	5.1	1.24	0.58	60.76	29.58	90.34
	N_{90}	S_{15}	5.8	6.1	1.27	0.59	73.66	35.99	109.64
+ lime	N_0	S_0	4.3	4.2	1.12	0.54	48.60	22.68	70.84
	N_0	S_{15}	4.8	4.9	1.18	0.56	56.56	26.32	82.88
	N_{90}	S_0	5.6	5.8	1.26	0.58	70.56	32.48	103.04
	N_{90}	S_{15}	6.5	6.7	1.29	0.60	83.85	40.00	124.05

(John *et al*, 2004)

fertilizer application schedule. Research reports from Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala has evolved recommendations for micro nutrient use in several tuber crops. Table 7 shows the micronutrient recommendation for Cassava.

Table 6b. N use efficiency as influenced by lime and sulphur in rice

Treatment	Agronomic Efficiency	Uptake Efficiency	Physiological Efficiency
No lime, no S	11.1	0.33	34.20
No lime + S30	21.1	0.54	39.15
Lime + no S	14.1	0.36	40.37
Lime + S30	24.4	0.59	41.34

(John *et al*, 2004)

Table 7. Response of cassava to micronutrient application

Treatment	Rate(kg /ha)	Yield(t /ha)	Starch (%)	HCN (µg g-1)
Manganese Sulphate	25.0	26.8	27	101.7
Zinc sulphate	12.5	29.4	29.6	90.3
Copper sulphate	12.5	26.9	27.2	99.2
Borax10.0	28.5	28.1	96.8	
Ammonium molybdate	1.0	28.2	29.5	115.9
All	-	30.1	29.2	110.5
Control	-	25.4	27.6	119.6
CD (0.05)		1.604		

(Susan, 2010)

However, continuous application of micro nutrients at higher rates are found to affect the soil health and crop yield. The results of a long term experiment shown in Table 8 stresses the application of zinc not above a dose of 25 kg / ha and only once in 4 to 5 years in order to keep the available zinc concentration in soil well around the critical level.

Imbalances of nutrient elements within the plant can affect the plant health and consequently productivity. The yellowing of arecanut is believed to be a result of such imbalances of elements in the plant. This situation can reduce the resistance of the plant to the biotic stresses too. Reports are there that the mycoplasma infection of the arecanut which also can cause yellowing is due to the ill health and reduced resistance of the plant against stresses. Agronomic interventions have resulted in the reduction of yellowing in arecanut growing in lateritic soil. Differential nutritional management practices were evolved for containing yellowing of arecanut grown in

Table 8. Available zinc (ppm) in soil during 15 Rice crops

ZnSO4 (kg/ha)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	2.4	1.8	2.1	2.3	1.9	1.6	1.4	1.2	1.0	0.7	0.6	0.6	0.4	0.3	0.3
25	5.4	3.1	4.1	4.2	3.6	3.3	3.1	3.0	3.0	2.2	2.0	1.9	1.3	1.0	0.8
50	6.9	6.5	6.0	5.6	5.9	4.1	4.0	4.0	3.7	3.0	2.8	2.5	2.1	1.8	1.6
75	8.3	6.3	7.2	7.5	6.8	5.9	5.8	5.2	4.2	4.0	3.9	3.5	3.2	2.9	2.6
100	12.1	8.3	10.2	10.6	7.7	7.5	6.4	6.2	5.2	4.9	4.7	4.2	4.1	3.8	3.2

(Koruth, 2010)

different toposequences of the land (Jacob, 2007; Mercy & John, 2007). For arecanuts grown in the converted paddy fields a provision of minimum 75 cm deep drainage channels between two rows, yearly regular application of 150 g lime, 10 kg organic manure, NPK @ 100:40:200 g, 40 g sulphur, 60 g magnesium sulphate and 20 g zinc sulphate per palm is recommended to reduce the incidence of yellowing. In garden land the management is similar but for the provision of drainage channels, application of zinc and an enhancement in the dose of K bringing the recommendation to 100:40:250. In terraced uplands the organic manure dose is enhanced to 15 kg/palm together with 150 g lime, 100:40:250 NPK, 40 g sulphur, 60 g magnesium sulphate, 20 g borax and 20 g zinc sulphate.

The Indian rubber research institute has developed location specific recommendations for secondary and micro nutrients for rubber grown in lateritic belt. As the inherent capability of any plant type is fixed variability in yield can only be traced by management lacunae. As such low yields have to be attributed to management of which nutrition is the most important. Site Specific Nutrient Management (SSNM) is emerged to be the latest tool to enhance the productivity and yield. However, identifying the deficiencies and toxicities of nutrients and alleviating the problem is the pre-requisite for SSNM for various crops and it takes paramount importance in lateritic soil.

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Modern fungicides in Integrated Plant Disease Management.

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Global food security and food safety are the two most challenging tasks the policy makers and governments have to tackle with currently. It is the problem of hunger and malnutrition of the ever increasing world population due to non-availability of enough food on one side and the health risks of consuming unsafe food contaminated with toxic pesticide residues which are indiscriminately used to maximise production and the associated environmental impacts on the other side. The scope of expanding the area under cultivation is limited and the only option is to maximise the production using available and newer technologies and to minimise the losses. It has been roughly estimated that almost 40% of the overall harvestable agricultural produce is lost due to different biotic stresses out of which about 14% is lost due to different plant diseases alone and the rest is due to insect pests and weeds. It is simply unaffordable for any governments and all out efforts are needed to kerb such enormous losses by adoption of appropriate technologies.

The underlying principle of plant disease management is to employ all the available strategies, tactics and methods to minimise losses due to plant diseases. The different tactics employed include adoption of regulatory measures, cultural practices, biological control, physical control, chemical control and utilisation of the available host plant resistance. Many of these tactics were employed by farming communities from very early times onwards even though without naming it as integrated disease management .However the significance and importance of chemical disease management practices were more realised only after the outbreak of catastrophic Irish Potato Famine in 1845. With the landmark discovery of Bordeaux mixture in 1885, Professor P.M.A Millardet laid the foundation stone for the modern plant protection chemistry. What soon followed was the discovery and development of a series of broad spectrum organic protectant fungicides and its use for plant disease control became a routine practice in agriculture. With the development of systemic fungicides during early 1960's and the subsequent evolution of a series of chemically diverse group of site specific fungicides during the next decade, new possibilities and opportunities were opened up to farmers to tackle difficult plant

disease situations in diverse cropping systems. Concerns for the impact of these chemicals on the environment or on the applicator was nonexistent at that time and the application rates were very high ranging from 3kg to 20kg a.i / ha and had to be applied frequently as against the current use rate of 100 – 500 g a.i/ha. The increased use and overdependence on fungicides for disease management brought with it other problems such as fungicide resistant strains of the target fungus, its toxicity to non target organisms, increasing residue problems in food stuffs and persistence and pollution in soil, water and air.

With the development and introduction of modern new generation fungicides since 1970's such as Triazoles, Phenyl amides, Acetamides, Anilides, Anilinopyrimidines, Hyroxy qunolines, Strobilurines,Phenyl Pyrrols, Melanin synthesis inhibitors, CAA fungicides and plant defence activators, plant disease management became more easy than ever before. These compounds possessed most of the desirable characteristics of an ideal fungicide such as broad spectrum of activity, novel mode of action, less persistence, excellent environmental and ecotoxicological profile, less application rates and frequency of application, low residue problems and they fit in more suitably for use in sustainable integrated disease management strategies. These fungicides also conferred substantial benefits on food quality by controlling mycotoxin production such as aflatoxin, ergot toxins, Fusarium toxins, patulin and tenuazonic acid. In the current concept of integrated disease management, fungicides form a key component and often serve as the only dependable means of defence against fungal infections in the absence of suitable host resistance.

Crop disease management in India with new generation fungicides

Consequent to the liberalised economic policy reforms, Government of India is now very keen to provide all the available new technological advancements for boosting agricultural production . As a result most of the new generation fungicides developed and widely used in the developed world are now available here. For import, manufacture, transport, sale and use of any pesticide in India, it has to be first registered with the Central Insecticide Board Registration Committee (CIB&RC) after conducting extensive environmental and eco toxicological studies to prove its bio efficacy and safety. As of now almost 60 different fungicides and their combination products (both conventional organic protectants and the new generation fungicides) have been registered with CIB&RC and are widely recommended and used to tackle divergent plant disease situations in the country. More details about these compounds can be obtained from the CIB&RC website (www.cibrc.nic.in). Most of these fungicides are available and widely used in Kerala also and the major groups are discussed below.

1.Triazole fungicides

Triazoles are currently the largest selling group of fungicides globally for plant

disease management. The first compound was Triadimefon which was developed and introduced in 1976. Since then more than 35 different amazing varieties of triazole fungicides having excellent fungitoxic characteristics were developed during the past 30 years by suitable substitution in the basic triazole structure of the compound and are extensively used to tackle diverse fungal disease situations in multitude of crops. They are broad spectrum compounds suitable for managing plant diseases incited by fungi belonging to the major groups such as Ascomycetes, Basidiomycetes and Deuteromycetes. The characteristic mode of action of these compounds is the inhibition of sterol biosynthesis of fungal cell wall in those fungi possessing it. The frequency of development of fungicide resistance against these compounds is comparatively low in target pathogens. These fungicides are required in much less quantity (ranging from 100 -500 g a.i./ha) and the frequency of application per growing season is less. Many triazole fungicides are ideal candidates to be used in integrated disease management strategies and are now mostly used in fungicide combination products. Altogether eight different modern triazole fungicides have been registered for use in India (Table – 1) and are widely used either singly or in combination with other fungicides for achieving maximum crop disease management.

2. Strobilurin fungicides

Strobilurins are naturally occurring antibiotics produced by certain Basidiomycetes and Ascomycetes associated with rotting of pine wood. Although these naturally occurring compounds are excellent fungitoxic substances they are highly unstable in nature and hence cannot be used commercially. However when strobilurin fungicides were evolved as synthetic analogues of strobilurin antibiotic, first during 1996, they were hot picks due to their unique characteristics and excellent fungitoxic spectra. They are the second largest group of fungicides used globally for plant disease management now. Azoxystrobin which is the flagship product in the group is currently the most extensively used fungicide globally in commercial agriculture. These new generation compounds possess new and novel mode of action by inhibiting energy production in the target pathogens at a new site in the cytochrome bc1 complex in the respiratory process. Further, they have the broadest spectrum of activity against all the four major fungal plant pathogenic groups at very low rates. They are the only group capable of controlling both downy mildew and powdery mildew at the same time. They possess excellent protective, curative and erradicant properties with very low mammalian toxicity, low bioaccumulation potential, low residual toxicity and are an essential component in integrated disease management practices. However the high resistance risk of the target organism against the group warrants greater caution during their use. The compounds are more preferably formulated with other fungicides as comby formulations to facilitate better spectrum of activity against a range of pathogens of the crops and as a means of combating the resistance risk. Although more than eight strobilurin

Table 1. Dose and usage of Triazole fungicide

Common name	Trade Names	Formulation	Use and Dosage
1) Triadimofon	Bayleton (Bayer crop science)	25% WP	Systemic foliar fungicide with protectant, curative and eradicative action against powdery mildew, rusts, leaf spots, blights and bunts.Dose – Coffee rust @0.08%; Grapes powdery mildew @0.1%; Wheat bunt @500 g/ha and Wheat powdery mildew @250-520 g/ha PHI – 45 days
2) Bitertanol	Baycor (Bayer crop science)	25% WP	Systemic, protectant, curative and eradicative fungicide effective against several diseases.Dose – Apple scab -0.075%; Groundnut rust @2g/l and Wheat bunt @1 g/l. PHI – 30 days
3) Hexaconazole	Contaf Contaf Plus Samarth (Rallis) Trigger (Biostadt)	5% EC 5%SC 2% SC 5% EC	Broad spectrum systemic with protectant and curative properties, effective against coconut leaf rot, rice sheath blight and blast, tea blister blight, soybean rust, mango powdery mildew, groundnut tikka etc. Dose for most crops – 0.2%; for coconut – 2ml/300 ml water. PH – 30 to 40 days
4) Myclobutanil	Systhane Index	10% WP	Systemic with protectant and curative activity, safe to mammals, fish, birds, excellent control of powdery mildew, leaf spots and die back in several cropsDose – 0.04%; PHI – 21-30 days
5) Propiconazole	Tilt, Banner Result Radar	25% EC	Broad spectrum with protective and curative activity and effective against rice sheath blight, banana sigatoka, blister blight of tea, leaf spots, rusts, powdery mildew, smuts and bunt of cereal crops etc.Dose - @0.075 – 0.1% (0.75ml to 1ml /l in most crops. PHI – 30 to 45 days
6) Penconazole	Topas	10% EC	Systemic fungicides with protective and curative effects. Effective against powdery mildew, rusts, leaf spots scabs in cucurbits, grapes, pomefruits, Pulses, mango.Dose – 0.5 ml/l in most crops. PHI – 30 days
7)Difenoconazole	Score	25 EC	Systemic, protective and curative fungicide. Effective against Rice sheath blight @0.5ml/l (0.05%). Also effective against Tikka and rust of groundnut, fruit rot of pomegranate, powdery mildew etc. PHI – 20-25 days
8) Tebuconazole	Folicur Raxil	25.9% EC2% DS	Broad spectrum systemic with protective, curative, and eradicant activity, and improves crop health. Effective against rice sheath blight @750 ml/ha, also against powdery mildew and anthracnose of chilli. PHI – 10 days

derivatives are now extensively used to combat crop disease problems worldwide only four fungicides are registered in India and extensively recommended for disease management ether singly or in combination. Further details of these molecules are provided in the Table – 2.

Table -2. Dose and usage of Strobilurins

Common name	Trade Names	Formulation	Use and Dosage
Azoxystribin	Amistar	23% SC	World's largest selling fungicide. Broadest spectrum of activity, increased yield, Effective in wide range of crops against downy mildew and powdery mildew, fruit rots anthracnose, early and late blights etc. Dose 500 g/ha (0.1%) PHI - 5-7 days
Kresoxim methyl	Ergon	44.3% SC	Broad Spectrum activity, introduced in 2009, effective against powdery mildew, downy mildew, rusts, scabs, leaf spots and blast and sheath blight of rice.Enhancement in yield. Dose – 500 g/ha for rice. PHI – 30 days
Trifloxy strobin + Tebuconazole	Nativo	75% WG (Trifloxy strobin 25% + Tebucon azole 50%)	Broad spectrum activity, formulated as combination product, effective against powdery mildew, downy mildew, leaf spots, rusts.Protectant and curative with excellent rain fastness and translaminar activity specifically recommended against rice blight, sheath blight and glume discoloration @ 0.3 kg/ha
Pyraclostrobin	Insignia	25% EC	Protectant, curative and eradicant with translaminar mobility. Effective against late blight and downy mildew @1.5 – 1.75 kg/ha

Fungicides for managing diseases caused by Oomycetes

Oomycete is a fungal group comprising of devastating plant pathogens such as *Phytopthora*, *Pythium*, *Plasmopara*, *Perenospora, Pseudoperenospora*, *Scleospora*, *Scleropthora Bremia*, *Albugo* etc. Most of these pathogens have diverse mechanisms of survival and intrinsic methods of spread and are not easily amenable to disease management strategies. It has been estimated that almost 25% of the total expenditure on chemical plant disease management is spent for managing diseases caused by this group. Diverse groups of chemicals possessing different modes of action, disease control spectrum and toxicological profile are now available for tackling this group of disease. Important among them are Phenyl amides, Ethyl phophonates, Acetamides, CAA fungicides, Cinnamic acid derivatives,

Oxazolidinedione, Imidazolinone etc. Most of these chemicals are registered in India and the details of the list are provided in Table- 3.

Table -3 - Fungicides for managing diseases caused by Oomyceteous fungi

Common Name	Trade Names	Chemical group	Formulation	Uses and dosage
1) Melalaxyl	Ridomil Master Unilax	Phenyl amide	72% WP (Melalaxyl 8% + Mancozeb 64%	Complete spectrum of activity, effective against late blight, downy mildew, damping off, foot root, white rot *Protective, curative and systemic *Mostly co-formulated. *Resistance development in sensitive fungi Dosage - black pepper foot root @ 1.25 g/lit soil drenching. PHI - 21 weeks
2) Melalaxyl M (Melalaxyl M 4% + Mancozeb 64%)	Ridomil Gold	Phenyl amide	68% WP	Dosage @0.25% against foot root of black pepper
3) Fosetyl AL	Aliette	Ethyl Phisphonate	80% WP	Amphimobile systemicity, stimulating phytoalexin safe to non target organisms, protectant and curative and specific against phytophthora and downy mildew. Dosage - 2.2 - 3 kg/ha against azhukal disease of cardamom
4) Cymoxanil + Mancozeb (Cymoxanil - 8% + Mancozeb - 64%)	Curzate M 8 Font	Acetamide	72% WP	Rapid penetration, systemic and contact, effective against late blights and downy mildews @1500 g/ha (2.4 g/l). PHI - 15 days
5) Dimetho-morph	Acrobat Udimo	Cinnamic acid amide	50% WP	Locally systemic with protectant and Antisporulant activity. Effective against late blights and downy mildew @ 1000 g/ha (1.5 g/l). PHI - 25 days
6)Famoxadone	Equation Pro (Famoxadon 16.6% + Cymoxanil 22.1%)	Oxazolidine dione and acetamide	38.7% SC	Contact and systemic, effective against late blights and downy mildews @ 500 ml/ha
7)Fenamidone	Sectin (Fenamidone 10% + Mencozeb, 60%)	Imidazolinone and Dithocarbamate	60% WDG	Protective,curative and eradicant activity against late blights, downy mildew and damping off @1500 g/ha. PHI - 30-50 days

Other fungicide groups

Several other fungicide groups are also extensively used for tackling different disease management situations which include Pyrimidine derivatives, Carboxanilides,Systemic organic sulphur fungicides, Cyclopropane Carboxamides,

Phenyl urea, Dicarboxamides and other new protectant fungicides such as propineb, Copper hydroxide etc. details of which are provided in Table – 4.

Table -4 - Other new generation fungicide groups

Common Name	Trade Names	Chemical group	Formulation	Uses and dosage
1) Fenarimol	Rubigan	Pyrimidines	12% EC	Effective against powdery mildew in different crops, apple scab etc Dosage @0.4 ml/l. PHI - 15 days
2) Thifluzamide	Spencer	Carboxanilide	24% SC	Highly specific to rice sheath blight @ 1ml/l. PHI - 28 days
3) Isoprothiolane	Fugi one	Organic Sulpher	40 EC	Protectant, curative and eradictant against rice blast @ 1.5 ml/l. PHI - 60 days
4) Carpropamid	Protega	Cyclopropane Carboxamide	27.8% SC	Green chemical, ideal for IDM strategies, for management of rice blast @ 500 ml/ ha
5) IProdione + Carbendazim	Quintal	Dicarboximide 25% and Benzimidizole 25%	50%WP	Specific for rice sheath blight @ 200 g/acre
6) Pencycuron	Monceren	Phenyl urea	22.9%SC	Contact, protectant and foliar rice sheath blight fungicide @ 600 - 750 ml/ ha. 1PM friendly
7) Propineb	Anthracol	Dithiocarbamate	70% WP	Broad spectrum protectant recently introduced in India, effective against late blight, downy mildew, die back, brown leaf spot of rice etc @ 1500 - 2000 g/ha
8) Copper hydroxide	Kocide 101	Fixed Copper	77% WP	Better formulation, slow release of cupric ions, uniform particle size, effective against rice false smut @200 g/ha

Fungicide combination products

The current strategy of chemical crop disease management encourages the use of fungicide combinations rather than straight compounds with a view to broaden the spectrum of activity, to reduce the chances of development of resistance due to repeated use of the same fungicide, to reduce the cost of application and to combat different disease problems of the crop with a single application. The different combination products registered and used in India for crop disease management have already been provided in the earlier tables.

Recently Government of Kerala has banned certain pesticides as an initiative to adopt organic farming as the State's policy of Agriculture (Order no. GO (MS) No.116/ 2011/Agri .dated 7 -5 - 2011).Three fungicides have been banned as per the above order viz., Methoxy Ethyl Mercuric Chloride (MEMC), Edephenphos and Tricyclazole. Substitutes for these compounds have also been identified which are listed in Table - 5

Table - 5. List of Substitute Fungicides for the banned fungicides

Name of Chemical	Present recommendation for Crop/Pest as per KAU package 2007	Substitute chemicals	Colour code	Dosage/ha of formulated product
1. Methoxy Ethyl Mercuric chloride (MEMC 6% FS) (Red)	Rosewood damping off	Substitute is to be evolved through field trials. However, in case of exigency Bordeaux mixture 1% may be used		
2. Ediphenphos 50% EC (Yellow)	Rice blast	1. Carpropamid 27.8% SE 2. Carbendazim 50% WP 3. Isoprothiolane 40% EC 4. Kresoxim Methyl 44. 3% SC 5. Tebuconazole 25.9% EC	Green Green Blue Green Blue	500 ml/ha 500 g/ha 750 ml/ha 500 ml/ha 750 g/ha
	Rice Sheath Blight	1. Carbendazim 50% WP 2.Kresoxim Methyl 44.3% SC 3. Tebuconazole 25.9% EC 4. Pencycuron 22.9% SC 5. Flusilazole 40%EC 6. Hexaconazole 5%EC 7. Iprodione 50% WP	Green Green Blue Green Blue Blue Blue	500 g/ha 500 ml/ha 750 g/ha 750 ml/ha 300 ml/ha 1.0L/ha 2.25 kg/ha
	Rice Brown leaf spot	1. Carbendazim 50% WP 2. Propineb 70% WP	Green Blue	500 g/ha 2.0 kg/ha
	Rice sheath Rot	1. Carbendazim 50% WP 2. Carboxin 75% WP	Green Blue	500 g/ha 500 g/ha
3. Tricyclazole 75% WP (Yellow)	Rice Blast (Seed treatment)	1. Carbendazim 50% WP	Green	2g/kg seed

So the options of disease management are varied and choices are many. The success depends on the right choices of tactics and methods of plant disease management at the right time and in the right combination in an ecofriendly, economic, sustainable and synergistic manner so that minimum damage due to diseases occurs in the crop incurring least expenditure. Intervention with fungicides in an integrated disease management programme first starts with seed treatment. Healthy seed is the primary line of defence against plant diseases. Seed treatment not only eliminates seed borne inoculums but also enhances the level of protection of the germinated seedlings from infection by multitude of soil borne plant pathogens. Soil treatment/soil fumigation with chemicals is appropriate if a threat from soil borne plant pathogens is anticipated. Accurate knowledge and information on the nature and characteristics of the different diseases of the crop and information on the influence of the prevailing weather parameters on the probable outbreak of these diseases are essential for the timely intervention with fungicide applications. Application of chemicals during the early stages of disease development, precisely at the recommended dosages is vital in obtaining maximum disease management.

Repeated applications of the same chemical or chemicals of the similar nature should be avoided since it increases the chances of development of fungicide resistance by the pathogen. Alternating fungicides with different modes of action and with different disease control spectra and use of fungicide combinations with broad spectrum of activity are the ideal strategies to combat multiple disease pressures in the crop with minimum expenditure on cost of application. Judicious and need based use of fungicides for tackling multitude of disease situations in a crop at the recommended time and dosages is crucial in achieving maximum benefit with least damage to the environment , ecosystem and to the non target organisms. Fungicides are a boon, not a bust to agriculture. It is a dependable and inevitable component in ideal integrated disease management strategies.

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