Agricultural Research for Development in the Asia-Pacific Region

Report on the E-Consultation

Introduction

Through a series of electronic and face-to-face regional and global consultations, the Global Forum on Agricultural Research (GFAR) in collaboration with the Consultative Group on International Agricultural Research (CGIAR) aims to reshape the global agricultural research agenda for development and reorient it to the needs of the poor through both the generation of new and relevant knowledge and the empowerment of rural communities to make use of all that is known. The consultation results will feed into the Global Conference on Agricultural Research for Development (GCARD), 2010. The process is being supported by Asian Development Bank (ADB) and Asia-Pacific Association of Agricultural Research Institutions (APAARI).

The e-consultation in the Asia-Pacific region (South, Southeast and East Asia and the Pacific) spanned from 1st to 24th September. Nearly 100 different participants for a total of about 350 messages and 110,000 words had actively participated (details as per sub-regions and sectors will be sent separately).

Key Agricultural Development Issues

The stakeholders had endorsed a list of important issues (16 main drivers and 53 specific challenges) of agriculture-led development in the Asia-Pacific region (sent along with the list of ten questions). The key issues are grouped as below:

(i) ***Fighting Stubbornly High Hunger and Poverty:*** Stubbornly high hunger, undernutrition and poverty and high dependence on agriculture, especially for employment and livelihood, bridging the huge yield gaps by doubling the rates of growth of yield and income while improving input use efficiencies particularly in the vast rice ecologies and rainfed areas which are often the hunger and poverty hotspots;

(ii) ***Synergizing Productivity, Sustainability and Equity – Towards Evergreen Revolution:*** Extremely high and growing population pressure, nearly 75% of the world's agricultural population cultivating only 37% of the world's agricultural land under increasing land degradation, water scarcity and biodiversity erosion, thus underpinning the urgency of enhancing productivity in perpetuity by developing and adopting ecotechnologies towards creating an Evergreen Revolution;

(iii) ***Can Small Always be Beautiful – The Crisis of Entitlement:*** Predominance of small and marginal farmers and increasing land fragmentation, emphasizing the need to generate technologies suited to smallholders, to enhance labour productivity, and to enhance access to land, water, energy, inputs, credit and insurance;

(iv) ***Research – The Engine of Growth and Development:*** Centrality of technology, information, knowledge and innovations for development and to

promote informed diversification to optimise opportunities in horticulture, livestock, fishery and agroforestry and to meet the challenges of rising income, inequity, urbanization and human health, and to revitalise the technology generation and diffusion process;

(v) ***Linking Farmers with Markets*****:** Linking farmers with markets, strengthening post-harvest management, agroprocessing, value addition, enhancing food availability for the poor through market, trade and distribution reforms, safetynets and integrated on-farm – off-farm – non-farm employment and income; strengthening bio-security toward safe and green agriculture and facilitating international trade; and

(vi) ***Policy Support – A Must for Science-led Development:*** Policy options and actions for increased investment in agriculture and agricultural R&D, improving terms of trade for agriculture, participatory (involving public, private, NGO, CSO sectors and farmers) research, extension and education, input-output pricing, institutional and services supports, bioenergy, climate change management and minimization of distortions of crop-animal-soil-water cycles, regulatory measures and standards, gender sensitivity, and retention of youth in agriculture and agriculture-related activities.

Voices of the Stakeholders

The main messages emerging from the responses of the stakeholders on the ten questions have been summarized below. It is hoped that this rather extended summary will be internalized in the Regional Report.

Have the Research Agendas Addressed the Development Needs of the Resource Poor?

Generally, research agendas, particularly in the recent decade, have not addressed the needs of the resource poor sufficiently well. The inability of resource poor farmers to afford costly inputs and to take risks associated with new technologies has not been internalized adequately in research agendas.

Inadequate attention has been paid to sectors that are growing rapidly and have a lot of potential to reduce poverty, hunger and undernutrition/malnutrition through production and marketing of high value products e.g. horticulture, livestock and fisheries.

Research on rice, wheat and maize, particularly the development of high yielding varieties including hybrids, coupled with enhanced fertilizer use, irrigation and integrated pest management, had triggered the Green Revolution in the 1960s. The process had more than doubled foodgrain production, mostly through productivity enhancement, resulting in halving the levels of poverty and hunger between 1970 and 1995.

The Green Revolution, however, often due to inappropriate use of technology, had its liabilities, such as loss of biodiversity, environmental pollution, land and water degradation and increased incidences of pests and diseases. The total factor productivity

(TFP) growth rate has been continuously declining and the input-output ratios have become increasingly unfavourable.

Research agendas are often based on perception of certain experts and those having a set of goals towards pursuing science in the background of international waves of agricultural research, and often do not accommodate the views of farmers, priorities of states, status of input supply chains, market forces and edaphic factors.

Level and Cost Effectiveness of Investment in Agricultural R&D

Agriculture sector in the overall economies of Asia-Pacific countries is underestimated and undervalued and suffers from veritable asymmetries. In relative terms (percentage of Agricultural GDP), investments in agriculture and agricultural research have steadily declined in most developing countries, although in absolute terms, primarily due to boost in public sector investment in AR4D in China and India, the regional level investment had doubled between 1981 and 2000.

Some believe that the unsatisfactory productivity, food security and poverty situations are due to the fall in investment in agriculture, particularly in agricultural research since late 1980s. The fall in budget had also caused decline in the human resources for agricultural development which has created a generation gap in agricultural science.

The primary constraint for productivity growth decline over years is, however, not fully on account of low investment, but often because of depleting and degrading natural resources, improper resource management practices and non-availability of quality seeds and other critical inputs.

Notwithstanding the importance of cereals in the diets of people in Asia-Pacific, dietary changes towards increased consumption of livestock, horticulture and fish products are evident even in the diets of poor. Such changes demand commensurate changes in investment.

While agricultural and natural resource management research is undertaken to meet the various challenges, the different objectives require different research approaches and solutions. Although not mutually exclusive, there is hardly any analysis undertaken to guide balanced allocation of resources across these different objectives. This research gap should be abridged urgently so that the limited resources could be judiciously and effectively deployed.

Emerging challenges in climate change adaptation, water scarcity, soil fertility and biodiversity erosion, gaps in institutional and human resources development, increasing biotic stresses and biosecurity concerns call for both increased resource allocations and their effective and transparent utilization (monitoring, evaluation and impact analysis should be an integral part of all research programmes).

Conventional research has been badly affected by preferential investment in biotechnology, and the asymmetry should be corrected. There is underinvestment in socio-economic and natural resources management (NRM) research, thus adversely

affecting the development of more effective policies, the functioning of institutions, capacity building and the decisions on investments with focus on inclusiveness and the poor, and the development of rainfed dry-lands and other environmentally non-congenial areas.

More recently, nonetheless, in some countries there has been some shift in emphasis on research on resource conservation technologies for resource-poor farmers in disadvantaged eco-regions such as rainfed, upland, hilly, arid, and semi-arid areas. But their visible large scale impacts are neither widely demonstrated nor up-scaled.

A balanced investment is called for catering to the needs of research for maintenance, for extending the benefits to new areas such as dry lands, hills and mountains, small island countries and coastal eco regions, and for attaining new gains.

Shift in Research Strategies

Low-input, but high return farm practices, integrated knowledge and farming systems based on organic farming principles (green agriculture and not strictly organic agriculture), participatory, interdisciplinary and multidisciplinary research and extension approaches should be promoted towards meeting the food, nutrition and income needs of resource-poor farmers, increasing inclusiveness and ensuring resource conservation and sustainability.

Use of locally available natural and man-made resources should be promoted so that outputs are efficiently and cost effectively produced, generating direct benefits to indigenous populations, including the poor and women.

Emphasis should shift from mere knowledge generation to innovations by involving all major stakeholders, namely, farmers, agro-industry, CSOs and market players. Demand-driven AR4D models should be duly verified (action research) through formal but participatory research and extension teams under real farming situations and, based on merit, should be scaled up and scaled out.

The research led by commitment to a set of guiding values – poverty focus, gender inclusivity, demand-led and partnerships, as espoused by GFAR, can directly and quickly impact the poor. For instance, the widespread adoption of BRRIdhan-47, a salinity tolerant rice variety in Bangladesh was facilitated by the Poverty Elimination through Rice Research Assistance Project (PETRRA) 0 a multi-partner project which had impacted the livelihood of thousands of households. "It showed that change within traditional structures is possible. For poverty focus the partnerships need to be close to the ground. Technological breakthroughs that may be generated through advanced research can interface the resource poor and women through simple facilitating processes. And this needs to be incountry."

Science should help in resolving the conflicting views on the efficacy of organic agriculture as well as of biotechnology in meeting the objectives of alleviating hunger and poverty. If there are economic and nutrition and biosecurity niches for profitable organic production, farmers should certainly adopt/adapt those. Where farmers-friendly

agro-technologies generated through the use of biotechnology and the transgenic crop varieties and hybrids have a proven advantage and the science is clear about their impact on farmers' livelihoods, human health, biodiversity and the environment, not allowing farmers access to such technologies is difficult to justify.

Renewed commitment to productivity growth, especially at small farms, is needed. Building on mutual confidence and respect and based on comparative advantages, PPP should be promoted for technology generation and sharing.

Several of the small countries lack adequate scientific research capacity to address the veritable problems. The “soft skills” such as research planning, priority setting, impact assessment, innovative resource mobilization etc. are usually missing among scientists.

Researchers need to work more closely with development agencies and policy makers so that appropriate action research is pursued at the farm/micro level and to address also the needs of landless farmers, pastorals, small fishers and tribals.

Diversification should be commensurate with income, nutrition, soil and water availability and their conservation, employment opportunity, equity, women welfare, market trend and access, technology, labour and energy availability with research effort broadened to a range of crops and commodities including coarse grains, legumes, roots and tubers, fruits and vegetables, livestock, aquaculture and agroforestry.

Priority Researchable Areas

Productivity of crops and livestock should be enhanced through genetic improvement to increase their adaptation to heat, water, disease and pest stresses, besides being high yielding and rich in nutritional qualities.

Research should be intensified to enhance conservation and sustainable use of natural resources particularly land, water and natural ecosystems resulting in the reversal of the decline of the total factor productivity growth rate, more efficient and remunerative use of resources, enhanced resilience and improved competitiveness of the farmers, particularly in face of the climate change and economic vulnerabilities.

Prevention of post-harvest losses and efficient agroprocessing interventions should be emphasised so as to add value and create attractiveness to the products that are grown/raised locally and link them with both domestic and international markets.

The ownership of livestock is more egalitarian than the ownership of land, hence the accelerated growth of this sub-sector is expected to be more pro-poor. But, with the intensifying industrial large-scale and vertically integrated livestock production and distribution, the vast small scale livestock production is losing ground as also the environmental pollution is accentuating.

Can research and innovations save the small scale livestock production? The threat from transboundary animal diseases and epizoonotics has increased. Research emphasis should be on developing crop-live stock farming systems based on integrated food-fodder

breed-health and biosecurity management. Socio-economic and environmental implications of these developments should be critically analysed to provide policy guidance and to create regional institutions and mechanisms to meet the biosecurity challenges.

The Asia-Pacific is world leader in aquaculture and small-scale fisheries. Promoting an ecosystem approach to fisheries and aquaculture, research in this sub-sector should emphasise adaptation to the changes due to climate change, diversification of aquaculture through breeding, feeding and seed technology, improving water productivity in aquaculture, developing Best Management Practices in Aquaculture, biosafe and quality production and inshore marine fish management through stock assessment and regulated fishing.

Enhancing farmers' income, competitiveness and employment security

Poor economic, social and ecological access to food and declining farmers' income are the main causes (not production *per se*) of hunger. The lack of entitlement to productive assets (soil, water, livestock, fishery, poultry) is attributed to the poor policies, inappropriate technologies and lack of knowledge. Innovative approaches are needed to improve employment security by integrating on-farm – off-farm – non-farm employment and for adoption of growth strategy with equity, and provision of enabling environment to increase farmers' competitiveness.

Recognizing that the relative income of farmers has been sliding down consistently, the focus of research must shift from only production to the whole value chain. Production, processing and distribution of high value crops and commodities should be encouraged. Off-farm rural employment and essential facilities and infrastructure for primary health and education should be created with due emphasis on streamlining of input-output markets, agro-processing and value addition, particularly in horticulture and livestock sub-sector, and services geared towards the resource-poor farmers, including the landless and women. Research should lead to high-value labour-intensive employment opportunities.

A multipronged approach should be adopted to increase income of farmers through policy, social, infrastructure, technology and market development, with emphasis on productivity and inclusiveness. In case, despite all efforts, the farming households whose land and other farming endowments are not able to provide the minimal livelihood should be given informed guidance for facilitating them to exit farming with promising livelihood alternatives.

Bridging productivity and technology transfer gaps

Often, a good number of new technologies are not adopted. Reasons for the adoption gaps are (i) low profitability and low income, (ii) inappropriateness of the technology *per se*, (iii) knowledge and information gap, (iv) investment, input and infrastructural gap, (v) nonavailability of market for the intended products, and (vi) policy and institutional gaps.

Generally, the high cost input based technologies are not sufficiently adapted to the conditions of small and marginal farmers and their ability to take risks. The farmer will surely adopt an income yielding technology, voiced many.

More participatory action research and innovation approaches could lead to research outputs that are more relevant, both in regard to the technologies themselves and to the required context, leading to the development of affordable and appropriate technologies. This clearly emerged from the experience of the Indo-Swiss Collaboration in Biotechnology (ISCB), jointly funded and steered by the Dept. of Biotechnology (DBT), Govt. of India and the Swiss Agency for Development and Cooperation (SDC). Over the last 10 years, adopting the value chain concept, ISCB has been successful in transferring and upscaling its promising technologies to the end users by involving private sector, formulating appropriate policy framework, licencing agreements and establishing a Technology Advancement Unit.

Even the best of science must respond to a well identified need. It was reported that it took over 30 years for T58, a highly productive tropical forage grass to impact on a few poor farmer families because the scientists worked in isolation and in a 100 per cent "top-down" fashion. But, with a participatory approach, the same variety got quickly adopted widely both at large and small farms and became the driver of highly successful milk and income producing systems.

Economic viability and ecological compatibility of promising alternative farming systems for different farm sizes should be demonstrated through participatory modes at farmers' fields to build the confidence of the farmers in the R&D process and to identify the best mix of technology components and the processes for wide adoption of the selected technology packages.

Successful farmers should serve as resource persons to oversee the research and scale-up programs in a "farmer-to-farmer" module. They should lead/guide the extension system and there should be greater respect for the farmer as knowledgeable practitioner.

Lack of services support and of timely availability of quality inputs discourages adoption of new technologies, such as limited flow of quality seed from breeders' plots to farmers fields would delay variety replacement.

Policy instruments such as improved access to credit and crop and livestock insurance should be introduced to reduce risks. Farmer friendly technologies, such as low to no external input requiring, labour productivity enhancing, conferring high acceptability of products in local market, promoting local value addition, possessing desired nutrition, taste and cooking quality and reducing risks both in market and monsoon, will readily be adopted.

Research institutions are generally willing to be development friendly and even entrepreneurial but are not able to meet their commitments due to shortage of funds. There needs to be a better balance between a) long-term funding to ensure continuity and the ability to undertake long-term research and b) competitive short-term funding to allow fast response to emerging research challenges and to ensure quality and relevance.

Donor agencies must be willing to fund the more downstream efforts of R&D institutions. But, research grants should be linked to involvement of stakeholders in defining the research agenda and the beneficiaries. Risks, accountability and benefits of research must be clearly defined and results recorded. Innovative and progressive farmers should be trained to record data and maintain documentation so that their experiment, experience and learning is available to the agriculture scientists, professionals and other farmers.

Revitalizing innovation sharing and extension systems

Extension/technology/knowledge transfer systems have weakened (some voiced that the extension systems are "dead"). These must be revitalized and strengthened and rendered more relevant, dynamic, farmer-centric and development oriented. Common weaknesses include: (i) lack of connection between teaching, research and extension institutions and agencies, (ii) lack of cooperation between government, NGO and private sector, and (iii) lack of integrated approaches along the whole value chain.

Instead of trying to find common ground and exploiting their different strengths, public and private organizations involved in grassroot level delivery of information and technologies tend to ignore each other and push their own interests. Farmers are bombarded with confusing information from different sources and at the end they become indifferent even to good messages.

Traditional knowledge is the cornerstone of a production system and should be congrued with modern knowledge and innovations. However, one must also acknowledge that the traditional knowledge and technologies must also evolve over time. Groundbreaking discoveries in science and technology are usually not made because of traditional knowledge alone, but they can certainly help creating a new stock of future traditional knowledge.

Amidst the generally unsatisfactory situation of extension services, there are some good models of extension and support services by the private sector and NGOs, which should be supported by the public sector by establishing innovative public-private/NGO-market partnership.

The recent development in ICT, village knowledge centres, TV and radio networks should be used for sharing knowledge and information and to bridge extension centers to markets – a market-led extension. Several studies have revealed the efficacy of mobile phones in message sharing particularly for market information.

Farm schools established at farms of lead farmers have proved to be highly effective particularly for transfer of complex messages and technologies such as those related to integrated farming, integrated pest management, integrated plant nutrient management and integrated crop care, and the approach should be vigorously promoted.

Performance of scientists should be measured not by just number of papers published and number of conferences attended, but should be measured also by what the individual has

contributed to the farming community by providing improved practices/technologies and in having them diffused widely.

Appropriate IPR regimes should be established for patenting of new technologies developed particularly by the private sector such as hydrid seed, GMOs, farm machinery, fertilizer blends, and other research products.

Village agriclinics, training, especially of youth and women, and market-led extension have proved extremely helpful in technology transfer. With the increasing feminization of agriculture, women-friendly technologies and tools should be promoted and women training for shill, agribusiness and entrepreneurship development should become regular features.

Each research centre should have a strong outreach programme and a window of agribusiness. Effective SPS and quarantine facilities are essential for facilitating safe sharing of technologies and materials.

Farmer-market-value chain linkage

Farmers must be linked with markets and positioned along the value-chain to be enabled to capture most of the price paid by the consumer through promoting Producer Companies, Small Farmers Estates, Nucleus Estate System, Cooperatives and SHGs. They should be duly trained and incentivised to innovate and become change agent so as to be a part of the change that he/she aspires for.

The linkages should be further strengthened through contract, corporate and group farming, marketing cooperatives for farm inputs and outputs, introduction of agriculture commodity exchange and futures market for food and other agricultural products. Policies aimed at private sector-led development of value and supply chains for high value agriculture will further strengthen the linkages. Developing off-farm agro-based livelihood activities and agri-business enterprises will greatly complement the effort.

The Producer Company approach ensures that arranging finance, procuring quality inputs, crop insurance, cultivation, harvesting, storage, value addition, packaging and marketing are all done professionally. The profits generated from the value additions would go back to the farmers as dividends and bonus. The Producer Company in its own interest would take care of extension, technology packaging, sustainability and environmental aspects in association with relevant stakeholders, in addition to finance, value addition, marketing, etc.

Local governments should appoint climate change agents in rural blocks to provide on-spot assistance to ensure sustained production and supply.

Research should be carried out to ensure that the markets (domestic and international) are working effectively and there are minimal market risks and farmers are advised accordingly for production planning. This should be complemented by providing appropriate technologies, timely credit, business support services etc. Efficacies of

different agri-business models should be researched to provide effective guidance for their adoption.

New policy is needed for handling commodities (both perishable and non-perishable) on an order-based production mode (a type of contract farming; Minimum Support Price does not ensure such contract) wherein governments should secure public interest. The worthiness of a suitable design shall be through both backward and forward linkages.

Competitiveness of farmers in developing countries is adversely affected by non-tariff barriers in the globalised world. Increased emphasis is required on biosecurity, gene literacy and food and health safety at all levels, especially at the grassroot. Research is needed for undertaking comprehensive risk analysis and management along the value chain.

Enhancing attractiveness of agricultural education

Agricultural education is generally missing the spark and is not able to promote excellence in science and to make agriculture more meaningful and attractive to graduates and scientists and to render them more entrepreneurial.

Efforts should be undertaken to provide basic systematic agricultural knowledge to a much wider audience, preferably all stakeholders. Ideally, this could be achieved through collaborating with educational institutions to develop agricultural modules for rural primary and secondary schools and agriculture, natural resource management and livelihood security should be made a compulsory subject in all schools as launched in PNG. College/University curricula should include also traditional integrated agriculture systems. Desired infrastructure/labs and competitive salary/service structures are needed.

Effort should be restored to keep educating plant breeders, entomologists, pathologists, agronomists, crop physiologists and other traditional agricultural disciplines. Having an increased supply of biotechnologists is not an adequate substitution.

Since the job-market determines inflow of students in a given discipline, it is imperative that course designing shall be an ongoing marketing strategy of universities. New areas such as intellectual property management, molecular technology and adoption, marketability of knowledge and products are to be cared for.

Bio-security

Inter-country cooperation in research and surveillance, monitoring and control for managing trans-boundary diseases and pests should be strengthened. Monetary benefits should be provided to farmers practicing various safety measures and adopting Good Agricultural Practices. Advocacy to ensure biosecurity by decision makers is a pressing need.

Safety standards and regulations are to be the domain of enforcing system that guide the agriculturists and relevant stakeholders about the global demands and national interest

about these issues. Grassroot level literacy and awareness on these aspects can build up only when volumes of market-driven production find place in villages.

Reaching out to farmers through policy advocacy

Intensification of farming systems is essential if we are to meet the challenges of reducing poverty and feeding an increasing population but this must be done in a way that is environmentally sustainable, socially equitable and economically viable. In most countries policies aiming to achieve this are very weak. Agricultural and natural resources research (ANRR) has potentially a huge role to play in providing the evidence based on which such policies can be developed.

Unfortunately the research community is not very effective at communicating with policy makers and ensuring that information and knowledge is delivered to the right people at the right time in the right format. There is a need to a) better understand the processes leading to agricultural development policies and the contribution provided by research outputs, b) undertake research on how to strengthen the research-policy-practice interfaces to increase the impact of research outputs and c) train researchers on how to communicate and interact with policy makers.

The policy formulation and advocacy systems to guide farmers on biotechnology products and bio-fuel crops should be science-based to allow a consistent and well thought out long term policy. At present, it is primarily driven by multinationals. There is an urgent need to develop local capacity to address technological, food safety, social and environmental issues associated with these products.

In the Asia-Pacific region utilization of agricultural land for non-food crops adds challenges and pressure to food production and food security.

Policy advocacy and actions are needed on the following aspects:

- Accelerated agricultural productivity and income growth and inclusiveness to alleviate hunger, undernutrition and poverty,
- Research, technology and innovations for development with focus on the poor, especially the resource-poor farmers,
- Adequate public and private investment in agriculture and agricultural research, education and extension and in participatory REE, with focus on development,
- Institutional support for bridging yield, employment and income gaps,
- Integrated management of natural resources, biodiversity, inputs and biotic and abiotic stresses, including transboundary diseases, biosecurity,
- Fair trade, input-output pricing, access to domestic and international markets and management of market volatility, linking farmers with markets, Producers' Company,
- Climate change management – adaptation and mitigation of crop-animal-soil-water cycle distortions,

- Enabling mechanisms, public-private partnership, knowledge pool and human resource capital (trained youth and women in agriculture), and
- Improve infrastructure, particularly roads, and provide minimum amenities in rural areas.

Meeting the Challenges of the Pacific countries

In the Pacific countries, the situation is characterized by smallness, isolation, high transport costs, poor communication, poor or non-existence of ARD capacity, inadequate or absence of infrastructure (research facilities), devoid of ARD policy (not even understanding and appreciation of this), exposure to serious climatic extremes, resources degradation and often influenced by external policy advices that are usually detrimental to any local considerations, culture, traditions and societal norms. Locally, agricultural development is fundamental to social stability.

Very often considerations with respect to environmental/sustainability/protection are dominated and very little is attempted with respect to productivity enhancement and growth in the agriculture sector so as to secure at least basic livelihood (e.g. food security).

Agriculture in the Pacific countries must be treated as the agenda for development. Food security and basic survival should be at the heart of this recognition. All out efforts must be made to orient ARD options as a priority intervention based on location specific crops/commodities, issues, needs, solutions and opportunities.

As individual countries neither have abilities nor resources, regional and focused initiative be taken to establish regional ARD organization (s) with support from international development organizations such as ADB and supported well by regional organizations such as SPC and other national organizations such as PNG NARI, universities in the region, ACIAR, and CG centres of relevance to the region. Research agenda for development identified and prioritized by the collaborative mechanism should be adapted and implemented through a participatory mode involving local communities, the foremost aim being assured livelihoods and the happiness of the local people.

Three priority actions needed are: (i) enhancing and sustaining investment in agriculture and agricultural research and technology development, (ii) filling the extreme shortage of desired human resources, and (iii) establishment of appropriate institutions and mechanisms for collaboration, transfer and adaptation of technologies and innovations including technologies from mainlands, towards achieving food self-sufficiency and reliance.

These countries are not disturbing climates but due to the developed countries greenhouse gas emissions and increase in CO_2 levels the sea level is increasing and these countries are suffering. Therefore, the Pacific countries need international financial support and cooperation in advanced education and technology to adopt the change.

Build food and nutrition security based on local crops/commodities, particularly roots and tubers, in each community through diversified farming systems, resource management and a system of self reliant agriculture. Surpluses could focus on low volume high value products with long shelf lives. In order not to be held hostage to the global seed companies, sub-regional Pacific seed companies should be established by the local people as per needs of such states and their small-scale farmers.

Plantations (sugarcane, banana, coco, coconut, palm oil, root crops, tropical fruits, vegetables, etc) are their main crops with large production potential for domestic and international markets. Industrial crops are most suitable for commercial production as joint ventures.

Research on agriculture production systems in changing climate should have major emphasis on adaptation and mitigation measures. Atoll resources management and production of organics, livestock and fisheries products are priority areas. Corporate farming by Producer Companies may be the way forward to minimize transaction cost and to achieve economy of scale in many agricultural enterprises.

Public sector extension is almost nonfunctional. Private sector and NGOs have been successful in technology transfer and should be encouraged for the purpose. Distance education may supplement the effort. Local customs and social systems are rather strong and often impact the extension activities.

Fisheries account for 80 per cent of dietary protein intake in the Pacific, but the availability is declining and, if not corrected, the sub-region will face fish crisis within a decade. Inshore fishery as well as mariculture should be strengthened. Adaptation to climate change in small scale fisheries will require addressing both existing and known issues as well as building more general resilience and capacity for collective action at local scales.

Pacific countries need to create common groups or align with existing groups of countries that power political alignments to secure their interests. Certain existing moves are bearing fruits.