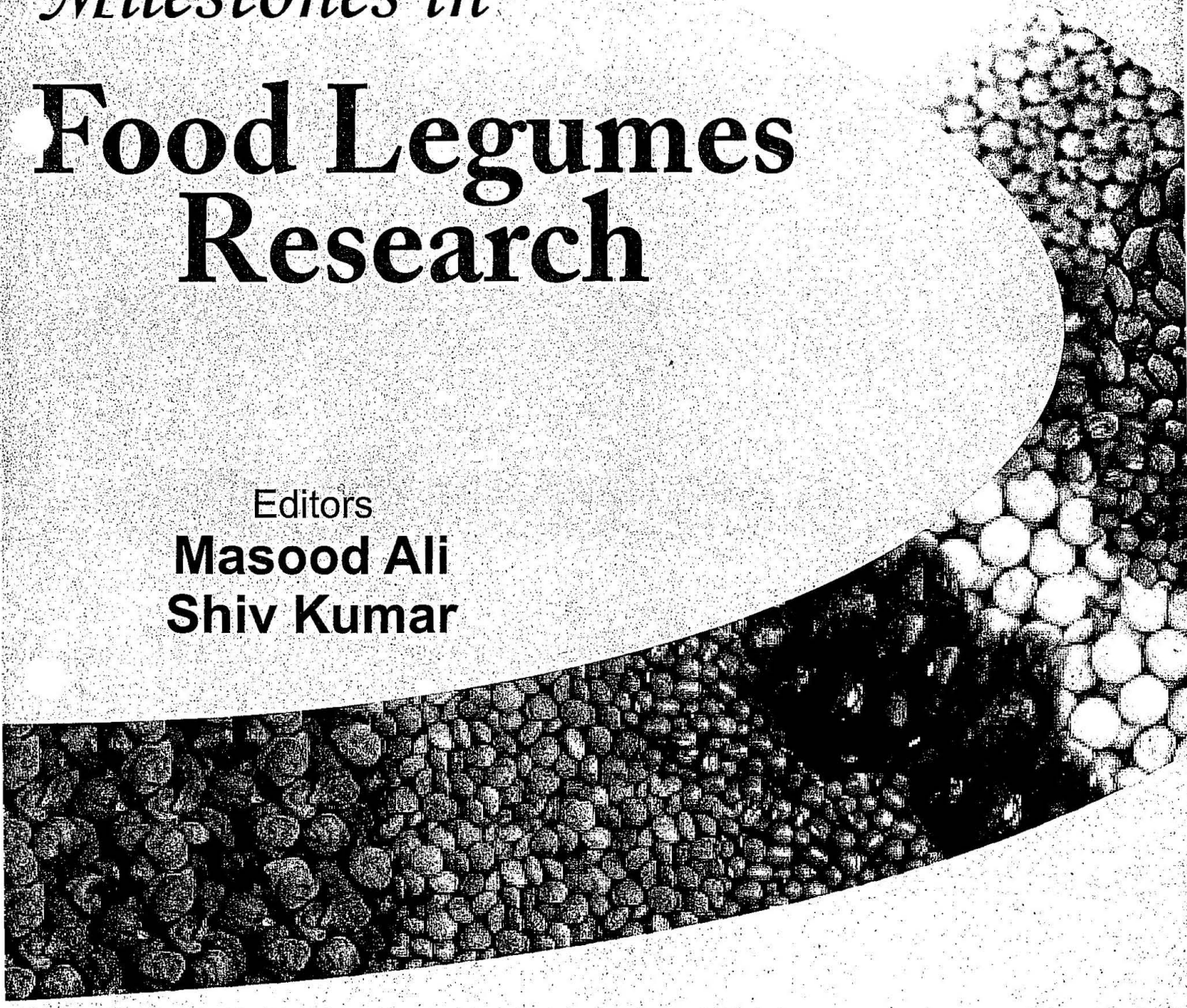
Milestones in

Food Legumes Research



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Expansion of Groundnut Cultivation in Southeast Asia : A Case Study of Vietnam

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INTRODUCTION

Groundnut scenario in South East Asia (SEA) and East Asia (EA) represents an interesting case study where countries such as China and Vietnam, in a short span of time, have occupied the driver's seat of the growth engine of groundnut in the world. Asia and Africa are the two major groundnut producing continents in the world. Based on 1980-2006 production statistics (FAO, 2006), Asia provided the lead in annual growth rates of yield and production (Table 1). Productivity and production of groundnut in Asia picked up substantially 1991 onwards with very little increase in area (Fig. 1). The major gains in production came largely through gains in productivity and China and Vietnam led the way in Asia.

Table 1. Annual growth rates of groundnut area, yield and production in Asia

	1980-2006		
Region	Area	Yield	Production
World	1.0	2.4	3.4
Asia	0.6	3.2	3.8
Africa	2.2	1.5	3.7

The advancement in groundnut production and productivity came along in a step by step manner with scientific achievements, governments' encouragement and the hard work of the farming communities in these countries. ICRISAT has partnered with the countries in the region and contributed towards their success in improving groundnut productivity and production in the region.

In contrast, India, in spite of having the largest area under the crop in the world, has lagged behind in groundnut growth (Table 2 and Fig. 2). Area and production show declining trends due to competition from other crops (*Bt* cotton,

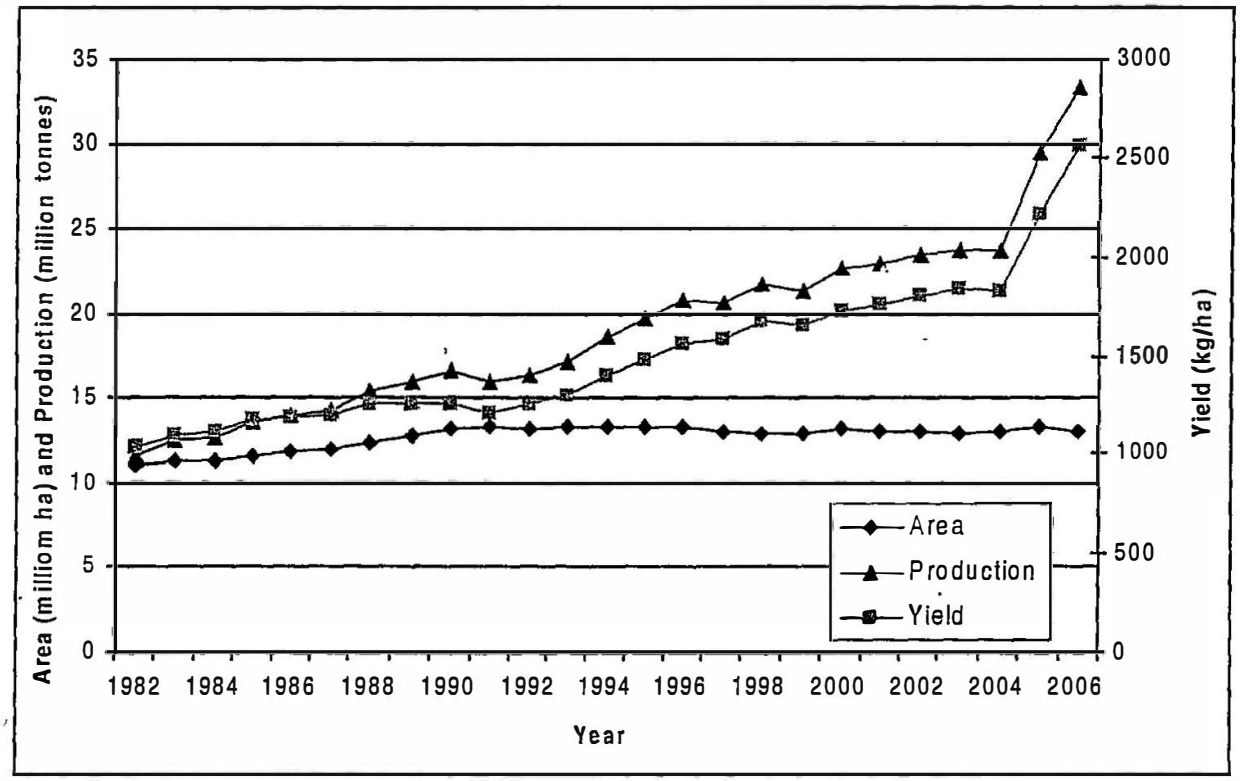

Fig. 1 : Three-year moving average of groundnut area, yield and production in Asia, 1980-2006

soybean, sunflower, *etc.*). Small gains in productivity have not been enough to compensate decline in area to maintain total production. The approach followed for irrigated agriculture during the Green Revolution has not delivered the similar results in rainfed agriculture. There is a need to revisit agricultural research and extension approach in India and bring in required changes in them to accelerate growth in rainfed agriculture in the country.

Table 2. Annual growth rates of groundnut area, yield and production in India, 1980-2006

Parameter	1980-89	1990-99	2000-06	1980-06
Area	1.6	- 2.3	- 0.30	- 0.71
Yield	2.0	1.0	0.06	0.94
Production	3.6	- 1.2	- 0.30	0.23

COLLABORATION

The formal partnership of ICRISAT with NARS in South East Asia (SEA) and East Asia (EA) started in 1986 with the establishment of Asian Grain Legumes Network (AGLN) with general objective of facilitating interchange of materials, information and technology among grain legume scientists at ICRISAT and in Asian countries. Since then, AGLN has evolved into Cereals and Legumes Asia

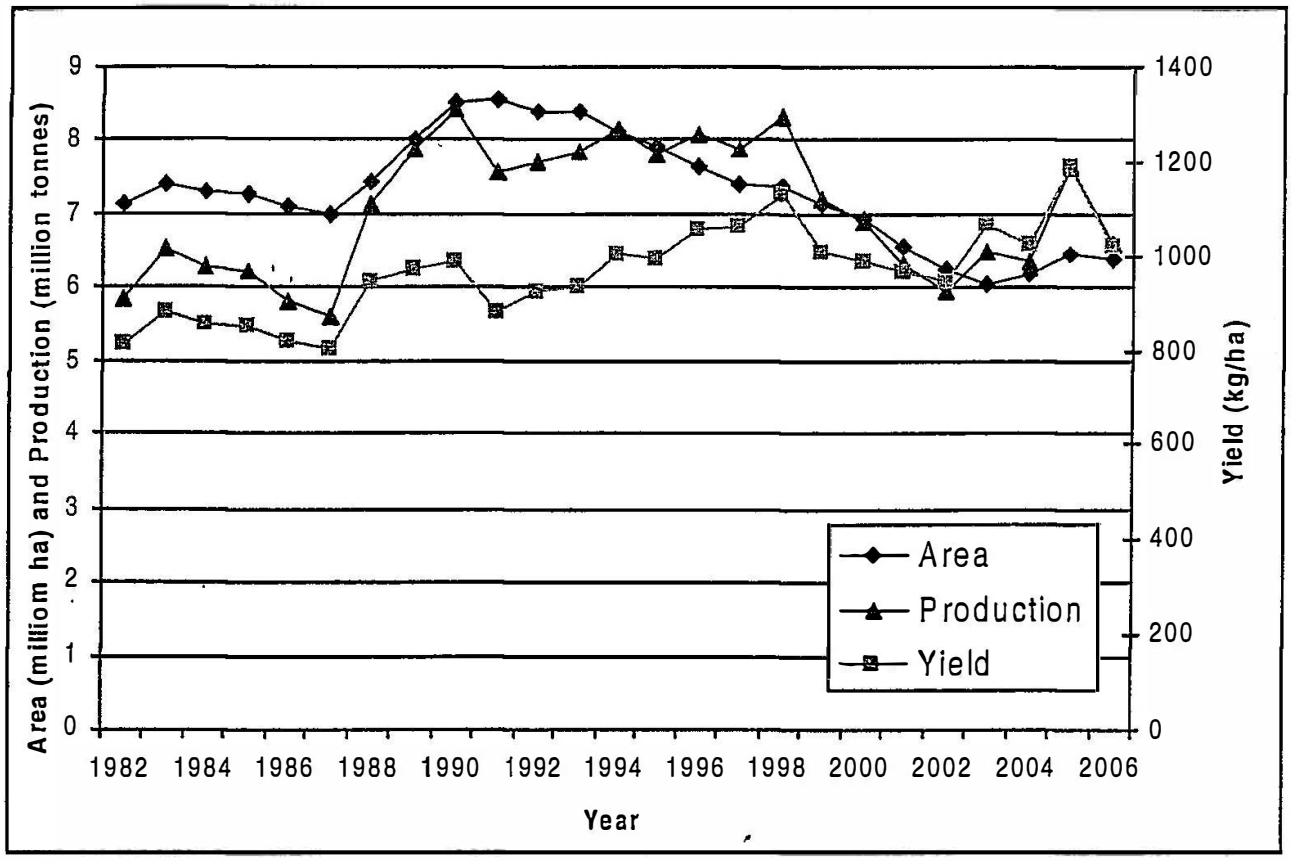

Fig. 2 : Three-year moving average of groundnut area, yield and production in India, 1980-2006

Network (CLAN) after merging with the cereals network. ICRISAT played a pivotal role in human resources development and provided need-based genetic resources and breeding materials to the region.

A CASE STUDY OF VIETNAM

Vietnam became a unified and independent country in 1975 after a prolonged war. ICRISAT's partnership with the Ministry of Agriculture and Rural Development (MARD; earlier known as Ministry of Agriculture and Food Industry, MAFI) dates back to 1989 when a MoU was signed between the two institutions. The research and development in agriculture sector in Vietnam was in its infancy at that time and ICRISAT invited the country to become a partner in a larger network of research and development in Asia. The scientists in the country had remained isolated from their fraternity elsewhere due to long-drawn war for independence. For effective and productive partnership, it was essential to update the skills of partners and help them to interact and develop contacts with international scientific community. The main focus of ICRISAT-MARD

collaboration has been on groundnut improvement and production research. In the early phases of collaboration (and even now), most of the agricultural research stations in Vietnam had little or no land of their own for research purposes. All the research was carried out on leased/rented farmers' fields through communes/local governments. This allowed support of local governments to new technologies and their faster adoption by farmers.

PRIORITY AREAS FOR COLLABORATIVE RESEARCH

The first ICRISAT mission to appraise groundnut situation in Vietnam was undertaken in 1991. A multidisciplinary team of scientists from ICRISAT together with the scientists from Vietnam Agricultural Science Institute (VASI), National Institute of Plant Protection (NIPP) in North Vietnam, and Oil Plant Institute (OPI) and Institute of Agricultural Sciences (IAS) in South Vietnam surveyed the major groundnut growing areas in the country and interacted with farmers and local leadership to identify groundnut production constraints and evolve appropriate research strategy to develop solutions compatible to local agro-ecological, socio-economic and political environment.

The current priority research areas include:

- Development of short- and medium-duration and confectionary type cultivars with high yield and resistance to diseases – early leaf spot, late leaf spot, rust, bacterial wilt and to insect pests – *Spodoptera*, *Helicoverpa*, white grubs and hairy caterpillar
- Agroclimatic analysis to calculate probabilities of drought and water logging incidences, designing appropriate ideotypes and identifying genotypes with enhanced drought and water logging resistance, and low temperature tolerance
- Management practices for control of aflatoxin contamination, damping off and collar rot
- Development of IPM techniques
- Development of appropriate *Rhizobium* inoculum production system and method of inoculation
- Diagnosis of nutrient imbalances and development of most economic alleviation measures

- Demonstration of high yielding varieties and improved crop production technology in farmers fields to obtain economically optimum pod yields of groundnut
- Economic analysis to quantify efficiency of groundnut production in various eco-regions of Vietnam under both sole and intercropping systems

SIGNIFICANT ACHIEVEMENTS

Capacity Building

Since 1989, 10 six-month in-service and 5 short-term in-service trainees, and 14 research fellows have undergone training at ICRISAT in various aspects of agricultural research and development with focus on groundnut. During 1995-2008, 33 Vietnamese scientists visited ICRISAT to participate in various events. Most of these scientists have stayed with groundnut crop after their training at ICRISAT. During the same period, 66 ICRISAT scientists paid visit to Vietnam and participated in groundnut research and development activities there. These visits resulted in information exchange, skill upgradation, development of joint research proposals, preparation of joint research publications and catalyzing collaborative research activities. ICRISAT sent two scientists (a breeder to OPI and an entomologist to NIPP) on 6-8 month assignments in Vietnam to organize the local research programmes and give hands-on training to scientists and technicians in their respective fields of specialization. Two scientists from Vietnam completed their doctoral research at ICRISAT.

Enrichment of Genetic and Breeding Resources

The farmers in Vietnam prefer groundnut varieties with short-duration (90-100 days), high yield, high shelling turnover, high oil content and resistance to diseases and insect pests. To facilitate *in-situ* selection and development of new varieties with farmer-preferred traits, ICRISAT supplied 68 sets of international groundnut varietal trials (36 to South Vietnam), 1327 advanced breeding lines (604 to South Vietnam) and 602 segregating populations (271 to South Vietnam) to Vietnam during 1991- 2008. In addition, OPI also collected and evaluated varieties of local origin and developed breeding materials locally. From these materials, OPI and Legume Research and Development Centre (LRDC) have developed/released the following groundnut varieties for cultivation in the country :

- LRDC released ICGV 86143 as LO 5 in 2002 in North Vietnam and Hung Loc station released ICGV 86015 as HL 25 in 2002 in South Vietnam.
- VD 1 and VD 5, developed by OPI, are approved by the Government for the eastern region of South Vietnam. In large production plots in Cu Chi, Trang Bang, Hoa Thanh, Duong Minh Chau, Vinh Cuu and Giong Tram districts, VD 1 gave 4-42% higher pod yield than the local varieties.
- OPI selected VD 2 from the segregating material supplied by ICRISAT. It is resistant to *Aspergillus flavus* infection. Other promising varieties awaiting release are VD 9 (ICG 8666) and VD 10 (ICG 8645). These two varieties are tolerant/resistant to bacterial wilt disease. ID 2, ID 3, ID 12, ID 13 and ID 14 are the promising drought tolerant varieties.
- LRDC also developed several high yielding varieties which performed exceedingly well in farmers' fields. These included L 08, L 12, L 14, L 18, L 23, L 24, MD 9, VD 2 and VD 6 among others.

Crop Nutrition

A substitute ACA (Alternative Coconut Ash) of natural coconut ash, commonly used as fertilizer in groundnut cultivation in South Vietnam, was developed by OPI and commercialized through a private fertilizer company. ACA is a fertilizer mixture that contains N, P, K, Ca, Mg (N = 4.6%, P_2O_5 = 11%, K_2O = 13% and MgO = 2.2%) and micronutrients in the amounts found in natural coconut ash. It reduces fertilizer cost by 24% and unit production cost by 10%. Similarly, to increase effectiveness of *Rhizobium* inoculation, a starter dose of mineral nitrogen (20-30 kg/ha) was recommended in South Vietnam.

In North Vietnam, lime application in two split doses (in lieu of gypsum as a source of calcium), either alone or in combination with *Rhizobium* inoculation and fungicide seed treatment, gave 22 to 29% more yield than the control treatment. The lime application gave increased income of US $ 130/ha with a benefit: cost ratio of 1: 18.

Plant Protection

Need based chemical application following pheromone trap data and catch crop gave effective control of *Spodoptera*.

Use of Growth Regulator

One spray of P 333, a growth regulator, at 50-60 DAS significantly reduced plant height and increased lodging resistance of plants and pod numbers per

plant. This resulted in 17-18% increase in pod yield with very little additional cost.

Use of Polythene Mulch

Use of polythene mulch in winter-sown (Jan/Feb) groundnut in North Vietnam gave 30-60% more pod yield than the farmer's practice. It improved germination, seeding vigour and crop growth. A combination of high yielding varieties and polythene mulch gave 50-80% more pod yield than farmer's practice. The technology is spreading quickly in Bac Giang, Vinh Phuc, Hanoi, Ha Tay and Nih Binh provinces.

Integrated Crop Management

The ICM package consisting of improved variety, polythene mulching, 40 plants/m^2, fertilizers (30-45 kg N, 90-135 kg P_2O_5, 60-90 kg K_2O, 400-500 kg lime applied in two equal split doses and 10-20 t FYM/ha), seed treatment with 0.2% thiram or rovral, one spray of P 333 at 50-60 DAS, IPM (use of pheromone traps for monitoring, 2 per village and growing sunflower as trap crop, one plant per 20/m^2, use of bio-pesticides and need based chemical control) and IDM (need based a timely application of fungicides).

Seed Production

OPI and LRDC have taken a lead in groundnut seed multiplication to ensure supply of good quality seed in required quantities to local governments and farmers. Seed is produced in farmers' fields under direct supervision of scientists form LRDC and OPI. A new cropping season, autumn-winter season (Aug/Sep – Dec/Jan) was introduced, to produce seed of groundnut varieties for the main spring season (Feb - Apr) when the seed requirement is very high. Introduction of autumn-winter season has helped to overcome a lot of logistic problems such as seed storage and transport associated with seed production. Local seed production results in 25-30% saving in cost of seed purchased from outside.

IMPACT OF COLLABORATIVE RESEARCH AND DEVELOPMENT

In 1980, the groundnut area in Vietnam was 106,100 ha with a total production of 95,200 metric tonnes and an average productivity of 897.3 kg/ha. In 1990, the area increased to 201,400 ha, the productivity to 1059 kg/ha and total production to 213,200 metric tonnes. They further increased to 244,900 ha, 1451 kg/ha and 355,300 metric tonne, respectively, in 2000. Now in 2006, the

area is 249,300 ha, the productivity 1865 kg/ha and total production 464,900 metric tonnes. The annual growth rates for different periods are given in Table 3.

Table 3. Annual growth rates of groundnut area, yield and production in Vietnam, 1980-2006

	1980 -89	1990 -99	2000 -06	1980 -06
Area	9.1	3	1.1	2.6
Yield	1.1	3.2	4.4	3
Production	10.2	6.2	5.5	5.6

During 1980s, the growth in production came largely from expansion of area under the crop. However, in the 90s, the growth in productivity contributed more than the expansion in area to the total production. The gains in productivity were the direct result of the collaborative on-station and on-farm groundnut research carried out jointly by OPI, LRDC, NIPP, IAS and ICRISAT. A large part of the credit for these significant achievements goes to Vietnamese farmers who are hard working and highly receptive of improved technologies. Currently, the area has almost reached a plateau though production, and productivity continue to rise (Fig. 3).

Having gained self-sufficiency and export status in rice production, the country now wants to replace rice production from low productivity areas with groundnut. As groundnut is a significant foreign exchange earner, the Government

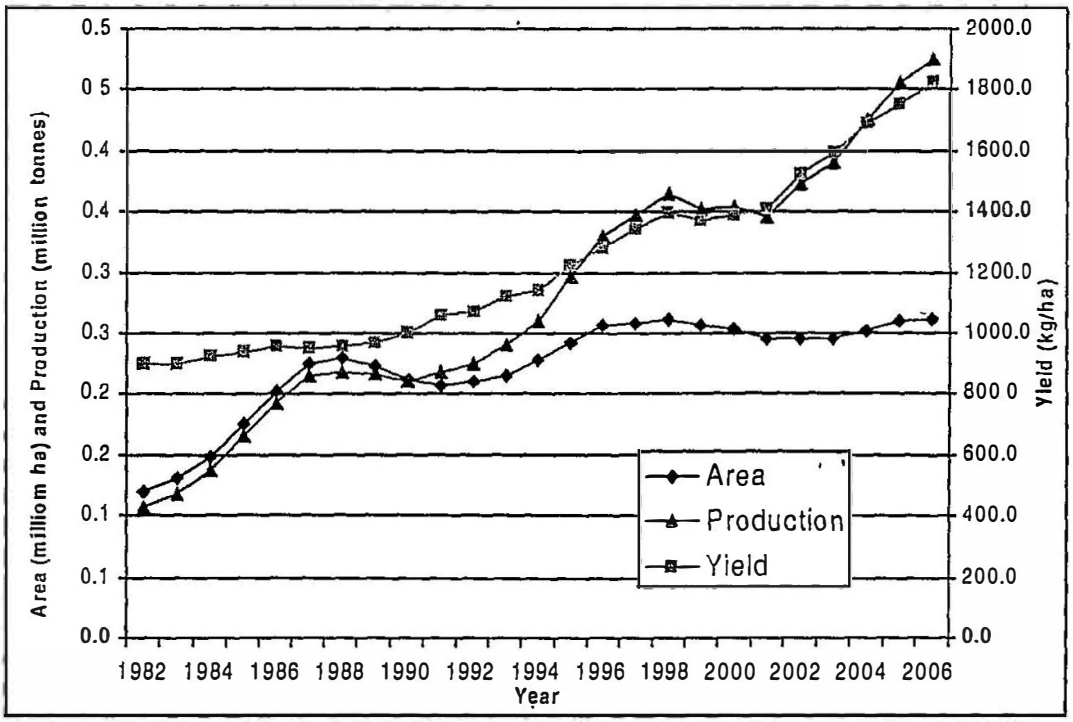

Fig. 3 : Three-year moving average of groundnut area, yield and production in Vietnam, 1980-2006

of Vietnam has set the target of 400,000 ha area for groundnut in 2010 (NIAPP 2002).

FUTURE NEEDS

Over the years, the oil use of groundnut has shown a declining trend and food use an upward trend. Therefore, for Vietnam to remain an important player in international trade of groundnut, it should develop varieties suitable for different food uses. A high quality produce free from aflatoxin contamination and chemical residues is the essential requirement for food use. A high oleic (O) to linoleic (L) fatty acid ratio is responsible for longer shelf life of groundnut products. For food use, varieties with high O/L ratio are preferred by food processors. Environment friendly, better and effective integrated crop management practices are needed to improve productivity and quality of produce.

LESSONS LEARNT

1. Strong commitment on the part of scientists, government officials and farmers is essential for the success of any agricultural research and development venture.
2. Partnership among and between national and international institutions ensures exchange of knowledge and technologies without any hindrance and provides synergy to research and development efforts.
3. Along with new varieties, there is a constant need to improve accompanying crop husbandry to realize full potential of variety x environment interaction.
4. Outputs of research conducted on farmers' fields have direct application and address the real issues affecting crop productivity at small farmers' level.
5. Farmers' participation and knowledge empowerment remain the key to the success and adoption of new technologies on a large-scale.
6. Support of local governments and their involvement in on-farm research ensures adoption of technologies in government-sponsored programmes for wider diffusion.

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