2. A Brief Look at the Historical Context of the FFS

The historical context out of which the FFS approach emerged was dominated by the agricultural projects of the Green Revolution. The approaches to agricultural development that were used in these projects were heavily centralised. At their best, the social engineering techniques of the Green Revolution were de-humanising. The final scenes of the Green Revolution were played out to the accompaniment of a warning note sounded in the Philippines. Researchers found that the projected demand for rice by increasing regional populations would eventually overtake surpluses generated through Green Revolution projects in Asia. These same researchers found that a significant number of farmers were out producing research stations. This flew in the face of the opinions of many experts who viewed farmers as the main problem in agriculture production instead of recognising them as potential problem solvers.

If extension was having problems, plant protection experts were able to create their own problems through the 1970's and 1980's by advocating the increased use of subsidised, broad-spectrum insecticides. Massive insect outbreaks were occurring that demanded a rethinking of crop protection approaches. The IPM FFS was developed in response to these conditions. The following is a brief review of the historical backdrop to the early development and spread of the FFS.

2.1 Small Farmers in Asia and the Green Revolution

Almost one third of the world's population consists of Asian farming households. Across the region, hundreds of millions of families make at least part of their living by tilling the soil. Among the developing countries in the region, the proportion of the population engaged in agriculture is estimated to range between 42% in Indonesia to 96% in Nepal. Most of the households that are involved in agriculture own or have access to small parcels of land. Observers have estimated that, in Vietnam for example, these "small-scale" farmers represent around 60% of the total population. Small-scale farmers are the bedrock of Asian economic development. Because of the importance of small farmers as producers of each nation's food and industrial raw materials, as consumers of goods and services, as managers of national resources, and as citizens, success in economic development largely hinges on the viability of smallholder agriculture and the vibrancy of social, economic, and cultural life in rural areas. The economic crisis that recently swept the region made this point painfully clear.

Three decades ago, an immense social and economic experiment was launched in Asia. The experiment, which has subsequently come to be known as the Green Revolution, was largely based on an "engineering" approach to smallholder agriculture. The main assumption of the approach was that small-scale farmer productivity could be raised if they had better access to certain inputs and used them according to a set of prescribed instructions. This approach was most successful when farmers had access to:

- Improved irrigation systems;
- Improved varieties of rice, wheat, and corn;
- Increased availability of inorganic fertilisers for the nitrogen responsive improved high yielding varieties.

Small farmers, particularly those located in well-irrigated areas with good soils, responded positively to the opportunities that easier access to these inputs presented. Farm productivity increased substantially. The average rice yields in the region doubled between the 1960's and the 1990's.

However, helping small farmers to build sustainable, productive agricultural systems proved more difficult than was originally supposed. Green Revolution programmes were designed to disseminate new technologies as quickly as possible. Because of the tremendous number of small farmers in most Asian developing countries, the dissemination process was greatly simplified to facilitate rapid adoption of new inputs and methods. In some cases the push for rapid adoption led to open coercion. Agricultural development programmes came to rely on highly centralised systems designed to deliver input packages and information to small farmers. Although this approach succeeded in introducing small farmers to the new inputs, new problems quickly emerged.

The centralised systems were unable to take into account the reality of pronounced agro-ecological diversity within countries, regions, and even within villages. The inclusion of routine pesticide applications within the input packages often caused severe ecological disruptions, most notably the rise of pest resurgence and resistance. Rather than reducing production risks for small farmers, the input packages frequently generated new, more serious threats to the sustainability and profitability of small-scale cultivation. Together with this disruption of the ecosystem came new threats to farmer health and the introduction of millions of tons of poisonous substances to the fields, waterways, food, and homes of rural people.

The inability of Green Revolution programmes to tailor input use to local conditions extended beyond pesticides to inorganic fertilisers and seeds. Centrally designed nutrient packages, in fact, required adjustment to local-specific soil conditions. The top-down extension of these packages did not give farmers the knowledge they needed to make these adjustments. Improved varieties were also introduced uniformly without assessment of local needs and conditions. In many regions production risks were often actually increased while local biological diversity was dangerously reduced. As a result, variation in yields increased in step with average yields and the marginal productivity of physical inputs began a long downward trend. More and more inputs were needed to achieve ever smaller incremental increases in production per unit area. (Kenmore, 1991)

Of equal, if not greater importance, were the social implications of the engineering approach to farming systems. The government agencies that sprang up to disseminate Green Revolution technologies were target oriented and often rigid in their interpretation of their mission. The pressure that these agencies put on small farmers to use inputs in accordance with centrally determined recommendations contributed to a 'de-skilling' of rural communities. Farmers were expected to be "progressive" and "adopt" new technologies rather than be active innovators.

2.2 The Importance of Being Expert

Asian farmers were producing enough rice for the populations of countries in tropical and sub-tropical Asia by the 1980's. Yields forged ahead of population growth. These yield increases owed much to the above-mentioned access of farmers to improved varieties, inorganic fertilizers, and improved irrigation systems. Then, in the late 1980's the work of a group of researchers from the International Rice Research Institute (IRRI) in the Philippines produced some disturbing news. Their work showed that rice production increases in Asia had hit a plateau. Rates of increases in yields fell from 4% per year to 2.4% per year. This was close to regional rates of population growth and the estimated growth in demand for rice for the 1990's of between 2.1 and 2.6%. (Rosegrant and Pingali, 1991). Their research also indicated that the yields on research stations had hit a ceiling established nearly 20 years before (Pingali et al. 1990) and that the highest yields obtained at the research stations were actually declining (Pingali, 1991). The major cause of these declining yields was found to be environmental degradation caused by intensive rice monoculture. The degradation of the rice agroecosystem, and there were many possible causes including micro-nutrient depletion, atmospheric pollution, pest pressure, and accumulative toxic changes in soil chemistry, was found to be greater than the capacity for genetic improvements in yield potential. The negative impact of intensified rice production increased the speed of the depreciation of investment in the development of high yielding rice varieties (Kenmore, 1991).

The IRRI researchers identified one robust source of potential yield increase, expert farmers. A survey of farmers in the provinces surrounding IRRI had been carried out at intervals from 1966 to the late 1980's. The survey showed that during those two decades farmer's yields had not plateaued. Surveyed farmers whose rates of yield were in the top one-third of yields in 1966 (their average yield was more than two tons below the highest yield at IRRI) had, by the late 1980's, increased their yield rates, on average, to more than one ton over those achieved at IRRI. The remaining farmers in the survey who in 1966 had an average yield of about four tons below IRRI's were able to increase that average to less than two tons below IRRI's. The IRRI trials made use of a standard set of management approaches, whereas the farmers innovated and improved. The gap between the average of the top one-third of yields and the average of the rest of the yields, was actually wider than that between IRRI and all farmers (Pingali et al, 1990). The researchers suggested that the major reasons for this gap were differences in farmers' abilities and differences in access to irrigation. The researchers further suggested that training of farmers would be increasingly important.

> "Training programs become particularly important as the incremental gains in productivity are achieved by adopting … 'second generation technologies' (such as better fertiliser incorporation technologies, integrated pest management, etc.) … more knowledge-intensive and location specific than the modern seed-fertiliser technology that was characteristic of the green revolution." (Pinglai et al., 1990)

Further, the IRRI researchers found that:

> "Farmers who have the ability to learn about the new technologies discriminate among technologies offered to them by the research system, adapt the technologies to their particular environmental conditions, and provide supervision of inputs to ensure the appropriate application of the technology." (Pingali et al., 1990)

This assessment of the capacity of farmers to learn and apply what they learned was drastically at odds with the assumptions of Green Revolution extension education systems. These systems assumed that "traditional" farmers required a complete refitting of their practises to become "modern". The time for a new approach to farmer education had arrived.

2.3 Getting the Bugs Out

The problems faced by Indonesia in dealing with brown planthoppers (BPH) were typical of those faced in all countries in the region. Indonesia's BPH woes began to be noticed in 1970 and 1971. Surveys of stemborer damage in selected sub-districts of West Java determined that where farmers were applying insecticides, not only was there increased stemborer pressure, but also BPH densities were ten times higher than in fields where insecticides were not used (Soehardjan, 1972). Prior to the seventies, BPH was not considered a pest. This situation soon changed. As part of the BIMAS Gotong Royong programme of the late 1960's and early 1970's, hundreds of thousands of hectares of rice were treated with aerial applications of broad spectrum organophosphate insecticide. The programme also provided "production packages" of in-kind credit that included chemical fertilizers and pesticides. As production went up, so did BPH infestations. In 1975, as the government began to directly subsidise insecticides, losses to BPH equalled 44% of the country's annual rice imports (Kenmore, 1991). This led the government to initiate aerial applications in 1976 of ultra low volume formulations of insecticide. These applications allowed huge areas to be treated. The result was that in 1976-1977, the brown planthopper caused severe damage to over 450,000 hectares of rice fields. The estimated yield loss was 364,500 tons of milled rice, enough rice to feed three million people for an entire year. (Oka, 1991).

BPH destroyed the crop in the insecticide treated field in the centre of the photograph. Compare to unsprayed field in upper part of photograph.

This was not an isolated occurrence. Indonesian crop protection policies that promoted the use of pesticides led to two other major outbreaks in 1979 and 1986. Thailand, Vietnam, Cambodia and Malaysia also experienced similar outbreaks. Population ecologists were able to document the process (Kenmore et al. 1984, Ooi 1988, and Settle et al. 1996). The brown planthopper was found to remain at insignificant population levels in intensified rice production under complete control by natural enemy populations <u>if</u> fields were not treated with insecticides. Even with immigration of large numbers of reproducing adults to a field, natural enemy populations were found to be able to respond and exact massive mortality on the intruders leaving rice yield unaffected. Insecticide applications were determined to cause disruptions in natural control. Survival rates of BPH in an insecticide disrupted system were found to increase more than ten times. With compounded rates of expansion this led to densities of BPH that were hundreds of times higher within one cropping season. Trying to control this kind of outbreak with insecticides was like pouring gasoline on a fire.

With the massive BPH outbreaks, plant breeders set to work to develop varieties that would be "resistant" to BPH. The strategy was to displace insecticide use with the planting of BPH resistant varieties. In the field, however, there continued to be intensive use of insecticides. Intensive application of insecticides actually encouraged a rapid selection among BPH for those who were able to overcome the "resistance" that had been bred into the new varieties. (Gallagher, 1984) The rapid breakdown of these varieties meant that the money and time invested in their development was lost.

Thus what had been standard government methods for crop protection in the 1970's and 1980's actually increased the risk of pest outbreak. The BPH example is illustrative of the process that, in general, precedes insect pest outbreaks in tropical rice. Insecticides degrade a system so that it no longer contains the natural enemy populations that can provide protection to that system. Government policy also failed to take into account another buffer to further enable a rice agroecosystem to avoid loss of yield. This buffer is the ability of a plant to compensate for the loss of leaves and productive tillers during the first 30 to 40 days after transplanting. Some high yielding varieties can withstand a loss of up to 30% of leaves and tillers during vegetative stage without a loss in yield. The compensation capacity of some of the widely grown high yielding varieties enables plants to withstand damage from pests such as stemborers, leaffolders, and others. (Way, Heong, 1994) Way and Heong in their 1994 paper conclude that, "IPM in tropical rice should be based on the contention that insecticides are not needed rather than that they are, and that 'pests' should now be critically re-assessed and proven guilty before insecticide use is contemplated."

2.4 IPM and Sustainable Agriculture

The above sections provide an outline of the set of problems that the FAO Regional IPM Programme faced in the late 1980's.

1. Pest resurgence and resistance caused by the indiscriminate use of insecticides posed an immediate threat to the gains of the Green Revolution.
2. Research demonstrated the viability of biological control of major rice pests, but such an approach required a broader understanding on the part of farmers (not to mention governments) of the ecological principles underlying the rice field agroecosystem.
3. Green Revolution extension approaches were actually "deskilling" farmers, not expanding their expertise. New approaches needed to be found for educating farmers.

While IRRI researchers found that the demand for rice was rapidly catching up to current levels of production, they also found that farmers had the capacity to learn, innovate, and even outperform research stations in terms of average yield. That farmers could become expert in farming had become a working assumption of FAO Regional Programme training activities by the mid 1980's. Based on that assumption, the FAO Regional Programme developed a new departure in Southeast Asia related to IPM and farmer education. This departure posited that the methods that were being used for the dissemination of technological packages among farm communities were fundamentally flawed. These methods were technologically driven, not farmer driven; centrally uniform, not locally adaptive. Given appropriate training methods that would empower farmers through learning, farmers could:

- Master the ecological principles needed to implement IPM in their fields;
- Become expert in IPM;
- Apply what they have learned to develop new initiatives and gain greater control over local conditions.

2.4.1 Developments in the Philippines

The first steps toward the creation of the IPM Farmers Field School approach were taken in the Philippines with a Farmer training programme lasting for five consecutive planting seasons from 1978 through 1980. (This section is largely based on a chapter by Matteson, Gallagher, and Kenmore, in Ecology and Management of Planthoppers, 1994.) Philippine rural sociology and community organising experts, extension officers, and an anthropologist and entomologists from IRRI made up the team that conducted this training programme. In many ways this was a research effort into how farmers could be trained in IPM. The training tried some important new methods that were found to be important in helping farmers learn IPM.

- Farmers were trained in small groups and were encouraged to be active in the discussions that arose during each training session.
- The training tried out an extended schedule of over three months with weekly two-hour sessions.
- Hands-on field practice was favoured rather than expensive materials, theory or lectures.
- Follow-up sessions by extension workers in farmers' fields were encouraged.

This initial farmer training programme was followed-up by a cadre of officers from the Crop Protection Division of the Bureau of Plant Industry. After 1982, the FAO Inter-Country Programme for Integrated Pest Control in Rice in South and Southeast Asia provided technical and financial support for the training effort. By 1984 about 200 "master trainers", 4500 extension agents and 55,000 farmers had been trained in IPM.

The Philippine farmer training effort made important innovations that were eventually incorporated in the IPM Farmer Field School in Indonesia.

- The rice field was used as a classroom.
- The "ballot-box" pre-test was developed as a field-based diagnostic test to determine learners' needs.
- Live samples were used for learning rather than photographs or drawings.
- Methodology shifted from lectures to structured experiences and analysis of field conditions.
- Experiments in season long training found that IPM training needed to be of longer duration.
- The approach posited that the most interesting and determinant element in the rice field was the farmer, not the insects.

2.4.2 Indonesia and Farmer Field Schools

The approach to farmer education that has been named the Rice IPM Farmer Field School incorporated the lessons from the Philippines' experience in farmer IPM training and was implemented first in Indonesia. The first FFS's were conducted in the rainy season of 1989-1990. In a few years the approach was being used throughout the region (see Table 1.1, below for data regarding implementation of FFS's in FAO Community IPM Programme countries). Field Schools give small farmers practical experience in ecology and agro-ecosystem analysis, providing the tools they need to practice IPM in their own fields. The FFS also provides a natural starting point for farmer innovation covering the whole range of issues relating to crop and agroecosystem management.

The FFS approach is based upon four "IPM Principles". The principles provide a guide to what farmers should be able to do because of participation in an FFS. These four principles form the working definition of IPM for the FAO Community IPM Programme. These principles are:

- Grow a healthy crop
- Conserve natural enemies
- Conduct regular field observations
- Become IPM experts

The first principle means that FFS participants will need to be able to apply good agronomic practices and understand plant biology. This should help alumni to optimise their yields as well as grow plants that can withstand disease and pest infestations. The second principle implies that FFS alumni will reduce their use of insecticides. To do this FFS participants will need to understand insect population dynamics and rice field ecology. The third principle asserts that IPM requires of farmers the ability to regularly observe, analyse, and take informed decisions based on the conditions of their agroecosystems. The fourth principle posits that because of local specificity, farmers are better positioned to be taking the decisions relevant to their fields than agriculture specialists in a distant city. Hence, FFS alumni should be able to apply IPM in their fields and also be able to help others do so.

The FFS approach featured several new departures from earlier IPM farmer education models. Included among these innovations were season-long training for farmers, field experiments, a focus on plant biology and agronomic issues, a new method for agroecosystem analysis, the inclusion of human dynamics activities, and a learning approach that stressed participatory discovery learning. (Training for IPM Field Trainers who facilitated these FFS's were intensive multi-season residential trainings. This approach to

TOT's was in itself an important innovation.) By mid-1990, over 50,000 farmers had participated in the first set of FFS's in Indonesia. The IPM Farmers Field School had started on its way to becoming the single most effective new approach to farmer education in Asia. At the 1999 regional meeting of countries who make up the membership of the FAO Community IPM Programme, extension education expert Niels Roling, stated that:

> "IPM FFS is the model for farmer education across the world. Other extension methods have been exposed as lacking the capacity to provide the education that farmers require in the increasingly complex agricultural systems that they manage."
> (FAO Community IPM Programme, 1999)

Policy Support. IPM and FFS implementation were supported by a fairly comprehensive policy promulgated in 1986 by then President Suharto. The new policy departure resulted from concern over:

- Another major BPH outbreak that had occurred in 1986;
- The threat that the outbreak would result in large imports of rice;
- The impact of imports on dwindling foreign currency reserves;
- The potential embarrassment these imports would cause for a nation that had declared itself self-sufficient in rice production and was not able to maintain this position.

Scientists were able to persuade several ministers of the ineffectiveness of intensive insecticide use (notably, the department of agriculture remained unconvinced). The scientists proposed an IPM programme based on a farm level IPM strategy, IPM training for technical personnel who would train farmers, and limiting the availability of broad-spectrum insecticides. The inter-ministerial coalition supported the proposal and took it to the president. The result was Presidential Decree No. 3, 1986. The decree called for farmer and field worker IPM training, the banning of 57 broad-spectrum insecticides from use in rice production and the eventual elimination of subsidies for insecticides (Oka, 1991). The decree created a policy environment at all levels of government that ensured support for rice IPM FFS implementation.

2.5 The Spread of FFS Implementation

Farmers throughout the region have responded enthusiastically to IPM FFS's, wherever they have been organised. Some farmers are primarily motivated by the reduced costs and reduced production risk obtained through application of ecological principles to crop management. Some are intellectually stimulated by the subject matter and excited by the experience of designing and carrying out their own experiments. For others, the main attraction is the group interaction, discussions, and debates that are an important part of every FFS. The most striking confirmation of this enthusiasm has been the spontaneous appearance of "Farmer to Farmer" FFS, in which field school graduates began to organise season-long FFS for other local farmers.

Indicative Numbers from Member Countries of FAO Community IPM Programme in Asia Implementing IPM Field Schools (through 2000)

Country	Year FFS Begun	Rice FFS	Farmers Trained	Other FFS*	Farmers Trained	Farmer IPM Trainers Trained
Bangladesh	1994	5,490	141,470	373	9,410	679
Cambodia	1996	670	20,000	85	2,500	254
China	1993	1,306	37,877	13	390	1,817
Indonesia	1989	37,429	935,152	6,388	159,600	29,522
India	1994	6,302	189,683			
Laos	1997	280	7,767	45	1,350	
Nepal	1998	209	5,415			156
Philippines	1993	6,000	180,000	1,200	336,000	
Sri Lanka	1995	510	9,700	34	610	240
Thailand	1998	525	12,027			
Vietnam	1992	19,876	515,927	1,993	55,098	6,178

*Primarily vegetable FFS, but also includes soybean and mung bean FFS.

Table 2.1, Country Data

Table 2.1 provides some indicative numbers concerning the implementation of FFS in Asia through 2000. The IPM FFS has become the approach for IPM training in the countries listed in the table. Most of these countries have also adopted national policies supporting IPM and limiting the use of insecticides.

The success of IPM FFS's has opened up a new approach to the development of sustainable, small-scale agricultural systems. Farmers, having demonstrated their enthusiasm for learning and applying ecological principles, have pointed the way forward to a future when they will no longer be viewed as passive recipients of recommendations generated in far-off research laboratories or central government offices. Farmers have displayed an intellectual curiosity to understand rice agroecosystem ecological processes and an eagerness to formulate community-wide approaches to increase the impact of IPM in their villages. Farmers are not only "taking part" in IPM activities; they are *taking over* IPM activities.