4 ANALYSIS AND FINDINGS

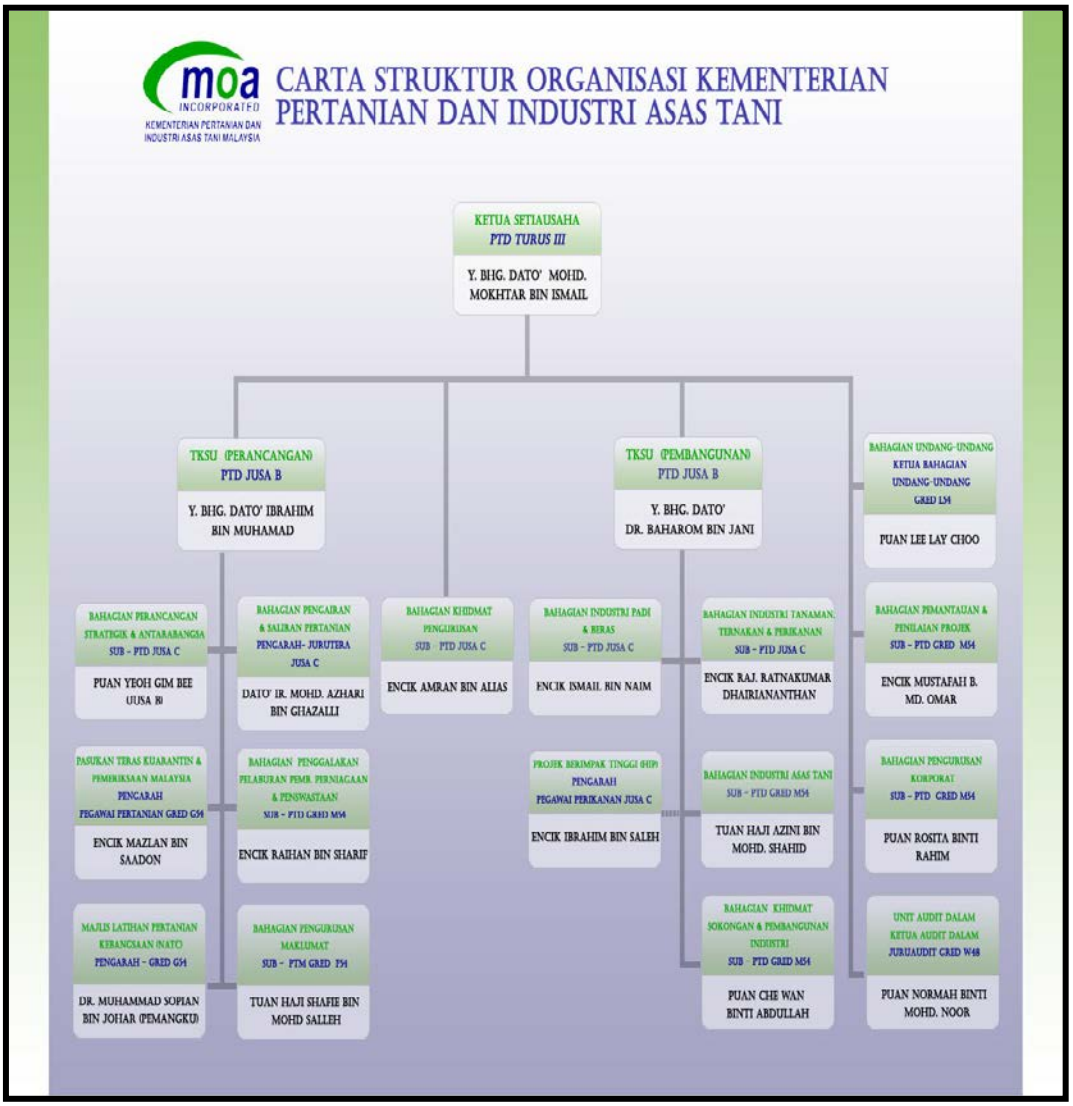
4.1 Introduction

In this chapter a description was made of the analysis that was conducted utilising the research methodology as set out in the previous chapter. This research methodology was designed to validate the appropriateness of the exploratory framework designed for enhancing the KAP of the agricultural extension officers such that they boosted the success rate of diffusion of IPM innovation. A summary was made of all the information secured through the multiple data collection methods employed. The flow of this chapter would be guided by the research design used in this study and would follow the structure of the principle data collection tool, viz., the questionnaire.

4.2 The Analysis

In Malaysia, the Ministry of Agriculture (MOA) looked into all aspects of the agricultural industry, viz., planting procedures, surveillance, new technology, regulations, the quality of the output and many other aspects. Some of the key roles of the Ministry were depicted in the organisation chart of the MOA, as shown in Figure 4.1 below.

Figure 4.1: Ministry of Agriculture Organisation Chart



One of the areas of the Ministry of Agriculture's jurisdiction included the eight rice granaries as depicted in Figure 4.2 below.

Figure 4.2: Map of the RICE GRANARIES in Malaysia

In this study, the focus was on the two largest rice granaries in Malaysia, namely Muda Agricultural Development Authority (MADA) in Kedah and Kemubu Agricultural Development Authority (KADA) in Kelantan. Brief background notes on these two rice granaries were as given below.

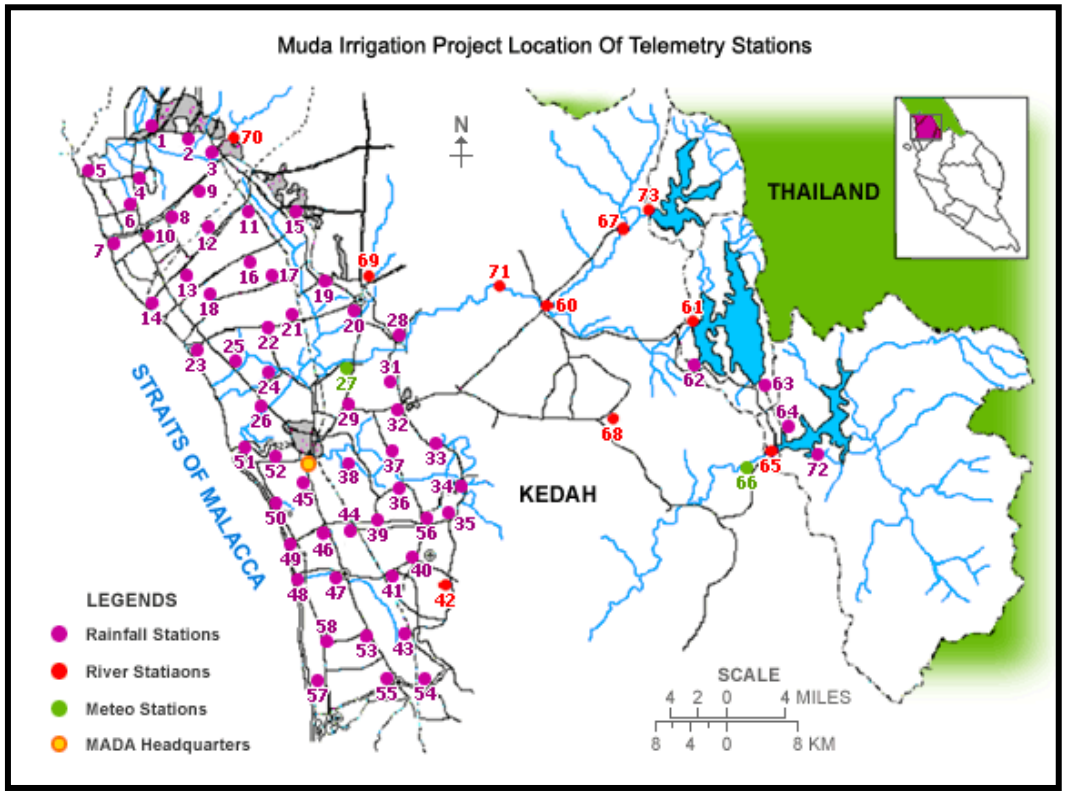
4.2.1 MADA

The Muda Irrigation Scheme is the largest rice granary in Malaysia. It is situated in the north-west Peninsular Malaysia, latitude 6^0 07' North and longitude 100^0 20' East. The irrigation scheme encompasses some 126,000 ha of the coastal alluvia plain of which 97,000 ha are cultivated with rice *Oryza sativa* subspecies *indica.* The coastal plain, 20 km wide and 65 km long is bounded in the east by low hills and on the western flank by the Straits of Malacca. At its centre lies Alor Setar, the capital of Kedah State.

Large scale rice cultivation in the Muda area began as far back as three centuries ago. By 1949 most of the current Muda area was already under rice cultivation. The rice agro-ecosystem in the Muda area could be considered as an extensive human-manipulated wetland where the rice crops and all other living organisms (biological factors) interact actively with the environment (physical factors). Long term human intervention through continuous activities in rice cultivation has led to complex biotic diversity challenges. These interactive activities resulted in far reaching implications on the tropic structures which in turn affected directly or indirectly the stability of the entire rice agro-ecosystem.

Below in Figure 4.3 is the map of MADA depicting the rice growing areas.

Figure 4.3: Map of MADA

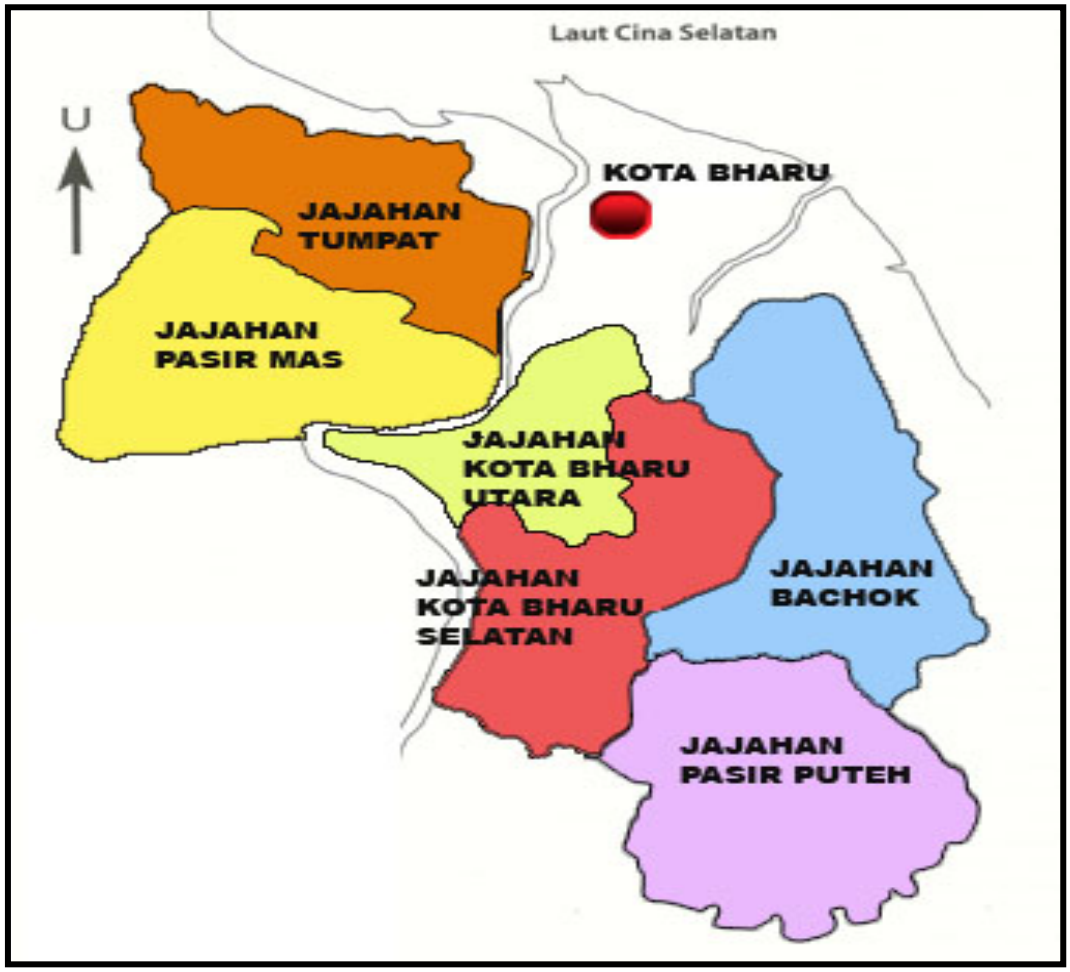


4.2.2 KADA

KADA (Kemubu Agricultural Development Authority) was established on the 30th of March 1972 through the Act 69 (1972) entitled Kemubu Agricultural Board Act. This was officially opened by Tun Hj. Abdul Razak bin Hussein, the Prime Minister of Malaysia on the 2nd of March 1973.

As soon as KADA was established, the Kelantan State Government approved the 1972 Kemubu Agricultural Development Authority Enactment (Kelantan 1972) that enabled the Ministry of Agriculture and Fisheries to carry out the 1972 Kemubu Agricultural Board Act from the 1st of August 1972. Kampung Kemubu which was located by Sugai Kelantan, 30 km from Kota Bharu, then made itself a part of KADA's history. Figure 4.4 below shows the whole rice growing areas of KADA.

Figure 4.4: Map of KADA



4.2.3 Minutes Review

A review of the minutes of previous meetings from the MADA office displayed certain findings. These included the following;

- The minutes that were made available were evidence of previous internal meetings conducted frequently. On the average, monthly meetings were conducted by the Heads of the Departments and their subordinates. However, there seemed to be a lack of control over the physical evidence of the minutes' book. Hence the regularity could only be validated for the minutes that were made available for review by the researcher.

- There were minutes of meetings organised or participated by MADA officials with other externally related organisations supporting IPM innovation diffusion. These included; the Malaysian Institute for Nuclear Technology Research (MINT), Food & Agricultural Organisation (FAO), Ministry of Agriculture, Agrochemical Organisations, National Ria Authority (BERNAS), Local State Authority, banks and schools. The minutes indicated that these meetings were scheduled on an ad-hoc basis to address some pertinent issues that may have arisen.

A review of the minutes of previous meetings from the KADA office displayed certain findings. These included the following;

- The officials at the agricultural office found difficulty in tracing the 'minutes' book. This was indicative of poor recording of meetings or there were few meetings conducted internally.
- Since there was no 'minutes' book, there was no documented evidence to corroborate the existence of meetings with any other related authorities or its frequency.

4.2.4 Unit of Analysis

The first level of respondents for this study encompassed the Heads of Department from MADA and KADA. Through focus group interviews with them, the researcher was able to secure a good overview of the IPM activities being currently performed by both regions under study. In addition, the Heads of Department were the respondents for Part I of the questionnaire. From the focus group interviews, the researcher was able to secure the responses that indicated the presence or absence of the six key variables that drove the successful diffusion of IPM technology and innovation or hindered the successful diffusion process.

The second level of respondents in this study consisted of the agricultural extension officers who were the front-liners to the end-users, viz., the rice farmers. They were the respondents to Part III of the questionnaire. In Part II their demographic details were captured so as to provide a good representation of their background. In Part III of the questionnaire, their Knowledge of IPM was assessed through a set of open-ended questions. The agricultural extension officers' strength of Attitude towards IPM was assessed through the ten 'dual-response' questions. This process was

repeated for the Practice of IPM questions, which were also presented through ten 'dual-response' questions.

In MADA there were a total of 170 agricultural extension officers while in KADA there were 42 agricultural extension officers. The Heads of Departments in the respective regions selected 50% of their agricultural extension officers to be the respondents to this research study. The chosen respondents were those who were directly responsible and currently involved in the IPM innovation dissemination process to the rice farmers within their jurisdiction.

4.3 The Findings

In this section, information secured from the questionnaire tool was reported. From the literature review, it was discovered that the presence of the six key variables would influence the agricultural extension officers' KAP level. These six key variables were; the role of top management; the structure and culture of the organisation; the prevalent social system in which these organisations operated in; the system of communication; the role of the intermediaries and also the attributes of the innovation. This was shown in Figure 2.5. Exploratory research methodology was utilised in this study; hence a case study and in depth interviews was conducted to identify the presence or absence of the six key variables that were critical for the successful implementation of IPM technology and innovation in the two rice granaries of MADA and KADA. According to the literature review, the presence of the six key variables would indicate that they were drivers of successful implementation of IPM new technology and innovation. While, conversely, their absence would indicate that they were inhibitors of successful diffusion

of IPM new technology and innovation. The description of the analysis was recorded under the heading of Six Key variables, as depicted below.

4.3.1 Part I : Six Key Variables

1. **Top Management** : The study wanted to investigate if top management provided the support in terms of financial resources, leadership and their commitment to augment the level of KAP among the agricultural extension officers.

MADA: The Head of Department organised an overview briefing for the researcher. This was well planned with strong support from the subordinates, namely the agricultural extension officers. According to the agricultural extension officers, their Head "***was open and willing to do the extra"*** for the IPM activities. They reported that they received "***updated and latest IPM research news***" from their Head of Department who was "***enthusiastic and excited***" about the latest IPM research. With the aid of top management, the Head of Department had set a vision of IPM for all in the department to gear themselves towards. It was apparent that his level of commitment and leadership was high. With respect to financial resources, there was no noticeable lack as they were supported well by the local government authorities, as commented by the Head, "***the budgets were presented to the Ministry and they endeavoured to support our activities, financially***".

Overall, it could be concluded from the interviews and observations that there was good support from the top management in terms of leadership and commitment and they even managed to secure the financial support needed to facilitate the smooth implementation of the IPM activities.

KADA: The overview briefing organised for the researcher was not well organised as compared to MADA with only a few of the agricultural extension officers being present. The Head of

Department was observed to be 'dragging his feet'. He claimed he was "***busy with the daily operational work***" and hence was quite reluctant to dedicate his time for the briefing. As the Head of the Department, he did not give IPM a high priority in his department. He did not work out a vision for the agricultural extension officers to be guided by. They were encouraged to continue their status quo with respect to their extension activities. It was observed that the level of top management commitment and leadership seemed to be lower than what was observed in MADA. Moreover, the agricultural extension officers present were not cooperative in responding to the questions posed by the researcher and they acted nonchalant and were non-committal. The researcher was unable to extract any reports or other documented evidence of their current IPM activities, as they claimed "***they had a lot of field work to do***". With respect to the financial resources, the funds for KADA's IPM activities were allocated on a yearly basis from the treasury's annual budget. However these allocations were small in comparison to the budgets allocated to MADA. The KADA board members lobbied for the budget allocation based on the agricultural extension officers' calculation of how much they needed to finance their IPM calendar of activities.

With respect to KADA, it could be concluded that the role of top management was less intense than that of MADA notably in the two pertinent areas of leadership and commitment while the financial resources were made available to the agricultural extension officers based on their intended IPM activities with the rice farmers within their jurisdiction.

A cross comparison of MADA and KADA's top management role displayed distinct differences. As to whether they managed to augment the level of KAP among the agricultural extension officers in their respective rice zones, it could be concluded that there seemed to be a stronger boost to the KAP level in MADA than in KADA.

2. **Structure and Culture** : The study wanted to determine if the structure and culture supported the agricultural extension officers' process of acquiring and understanding the new IPM innovation knowledge, so as to promote their level of KAP.

MADA: The structure of the organisation in MADA was hierarchical in nature as it was part of the government body. Hence it was steeped in formality and was not flexible in structure. However, the prevalent bureaucracy did not hamper the activities of the agricultural extension officers in respect of being responsive, open to change or adaptable to the new IPM innovations. This was evidenced as the agricultural extension officers possessed a keen sense of urgency in creatively designing the new literature, posters and brochures for their dissemination activities as "***we need to inform and educate the rice farmers soon***". There was great teamwork involved in undertaking the IPM tasks, being indicative of a supportive IPM culture.

The structure of the Farmers' Association in which the farmers were the members was also in tandem with the MADA organisation structure. Despite its rigid structure and not being a flatter organisation, the structure did not dampen the IPM activities. Rather it stimulated a positive culture among the farmer leaders, as stated by the agricultural extension officers "***the farmer leaders were eager to know the new ways and methods to improve their rice productivity***". Hence the prevalent Farmers' Association structure and culture facilitated the process of acquiring and understanding the new IPM innovation among the farmer leaders.

KADA: The organisational structure in KADA was similar to MADA, ie., being hierarchical and bureaucratic in nature. The inflexible structure did not play a major role in influencing the

decisions undertaken by the agricultural extension officers. These officers displayed that they were not too interested in the new information on IPM innovation. They were not too keen to prepare documentation for the rice farmers as "***this is not our main activity; rather, we need to check on the rice farmers and advice them***". Hence the culture at KADA was more focussed on the rice farmers' current stage of activity and having a personal touch to them rather than aggressively disseminating the latest IPM innovation to them through brochures or pamphlets. The agricultural extension officers felt that documented brochures and charts were not going to help improve the rice farmers' adoption of the IPM innovation. Hence their IPM culture of disseminating the latest IPM innovation was distinctly different from MADA's culture, even though both rice granaries had similar structure settings.

As a cross comparison, there was no difference between MADA's and KADA's structure as both were organisations that were under the umbrella of the government of Malaysia, hence the hierarchical format. The structure of the departments managing the IPM activities also fell in line with the bureaucratic format in both the granaries. Hence there was no clear structural difference. However, a cross analysis of their culture revealed a conspicuously different scenario. MADA possessed a culture of responsiveness, creativity and adaptability to instil the new IPM innovation to the rice farmers. The agricultural extension officers from KADA, on the other hand, possessed the culture of maintaining the prevalent scenario and dealing with the farmers' current issues and then slowly introducing the IPM innovation, rather than using a full blast emphasis on the new IPM innovation through brochures or pamphlets.

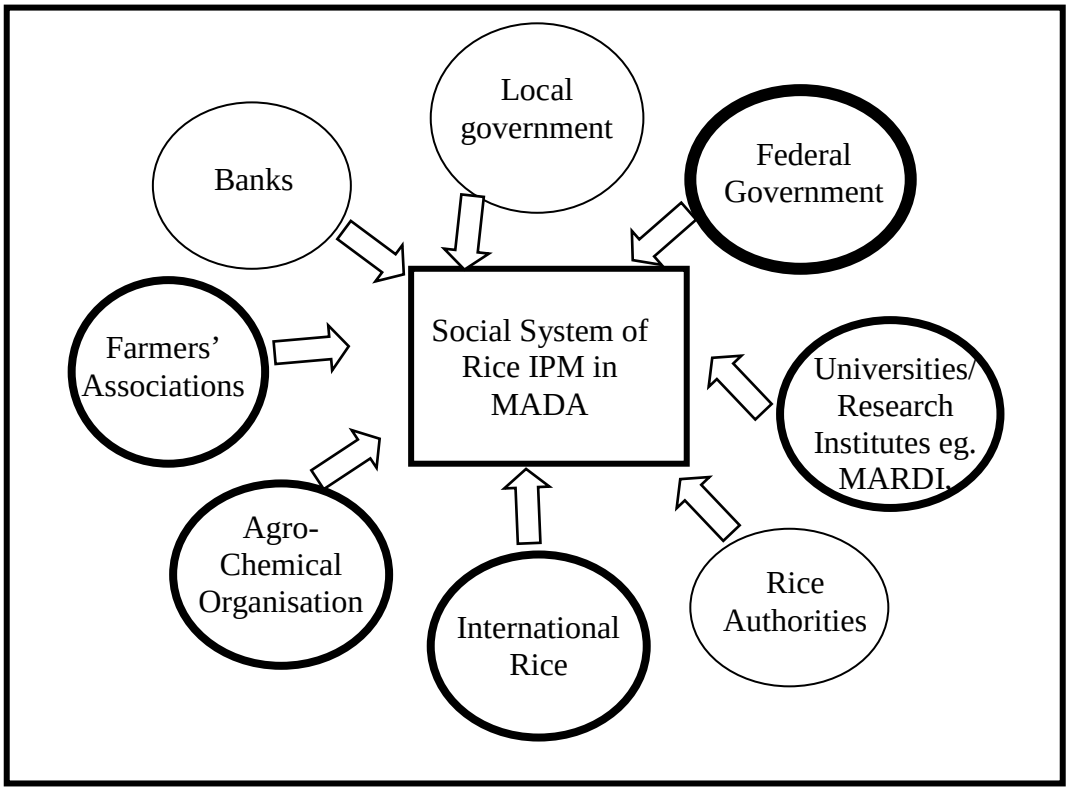
It could be concluded that both the granaries had different cultures which were aimed at achieving similar end-results, viz., of instilling in the farmers a higher level of awareness and

dissemination of the new IPM innovation. But the process of acquiring, understanding and enhancing the KAP of IPM among the two sets of agricultural extension officers, were distinctly different.

3. **Social System**: An analysis was done to investigate if there was a functioning social system comprising various IPM inter-related organisations needed for the complete support of IPM diffusion. By this it would help boost the KAP of the agricultural extension officers to a level such that they would increase their momentum on the IPM diffusion process to the rice farmers.

MADA: During the briefing made by the Head of Department, all the multiple IPM related organisations that formed the social system in which MADA was operating in, were identified. Some of the members of the IPM social system included; the University Research Units, Centres of Excellence, Technical Standards Organisations, Agrochemical Organisations, Rice Industry Associations, Financial Institutions, Labour Organisations, Local Governments, Federal Government and Communities which supplied Knowledge and Skilled Workers. A pictorial image of the inter-related organisations in the social system of MADA viz., the organisations who were involved in promoting the diffusion of IPM innovation to the end-users (rice farmers) through the agricultural extension officers was presented in Figure 4.5 below.

Figure 4.5: The IPM Social System in MADA



Some of the services rendered to MADA by the various components of the social system included the following;

a. Farmers' Association – they formed the backbone of the contact between the MADA officials and the farmers. They were the gateway for any new IPM innovation to be disseminated to the farmers on a larger scale. They played a key role in the social system of MADA.

b. Banks – provided financial support and assistance to the rice farmers in terms of loans for their purchases of rice grains, rice fertilisers, rice pesticides and others.

c. Local Government – provided services such as the computation of the local water and electricity rates for the rice farmers.

d. Universities and MARDI – exchanged research and development services with MADA to further enhance the successful implementation of IPM. They also played a key role in conveying latest and important research findings to MADA.

e. Rice Authorities – worked with MADA on regulating the quality of the rice grains to be distributed to the rice farmers so as to enhance the yield of the farmers' acreage and to control the onslaught of rice diseases.

f. IRRI – exchanged research and development services with MADA by introducing the latest IPM research findings and innovation. Their relationship with MADA was important as they fed the latest research findings to MADA who then transferred them to their agricultural extension officers.

g. Agrochemical Organisations – worked with MADA to introduce safer and cheaper sources of fertilisers for the rice farmers to control the level of pest attacks. This organisation also played an important role as they helped to educate farmers on better ways of dealing with the rice pests and rice diseases.

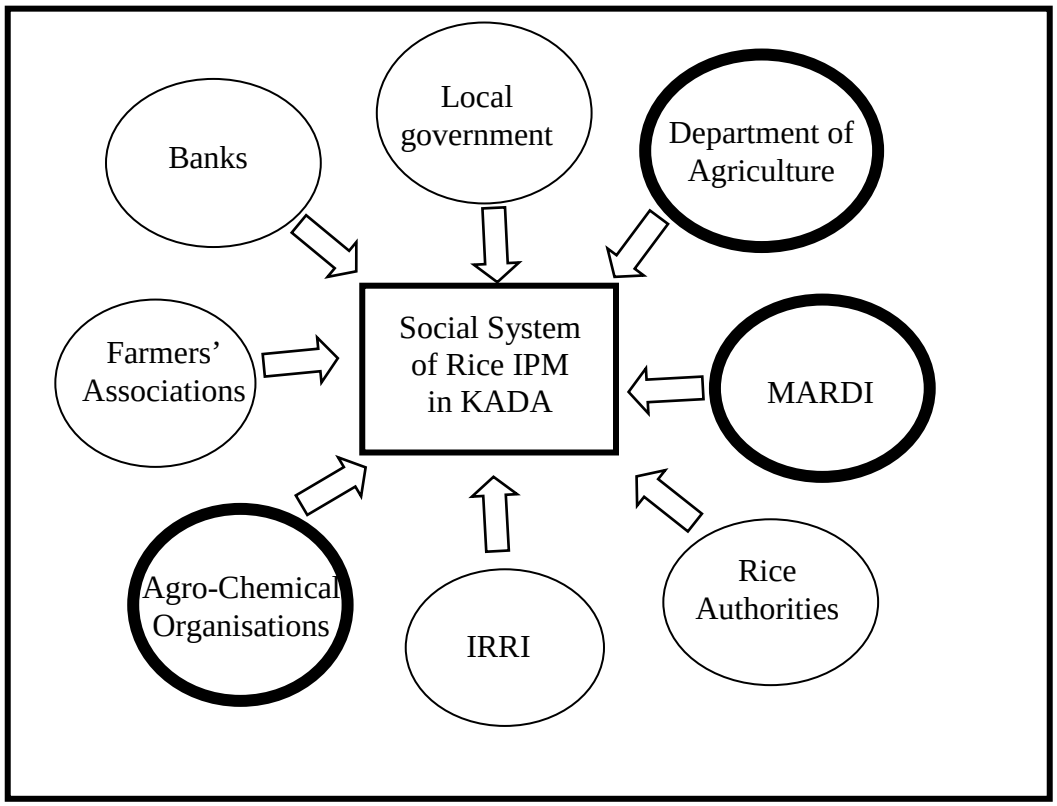
h. Federal Government – their involvement was mainly through the Ministry of Agriculture that provided support notably in the area of surveillance of pest attacks and also in the area of monitoring to secure the latest updated statistics of pest attacks. They played the most important

and critical role in MADA as they were the source of most of the key amenities and services needed by MADA.

On the whole, there were many components of the social system in MADA who provided relevant support for the implementation of IPM and other related activities. The strength of their relationship could be measured by the frequency, reciprocity and intensity based on the component members' expertise and strength to gain better information so as to promote the successful implementation of IPM innovation. The Head of Department shared that regular meetings and discussions were held with some of the component members over the multiple IPM issues and collaborative activities and the frequency of the meetings conducted was based on a need basis. The strongest component member was the Government as depicted in Figure 4.5 above, while the other four members that had a relatively strong relationship with MADA were namely; the Farmers' Association, the Universities and Research Institutes, the Agrochemical organisations and also IRRI, whose contact with MADA was through conferences which were held on a yearly basis notably in the initial years when the IPM concept was still in its infancy stage.

KADA: KADA's social system component parties were similar to those of MADA as they were under the auspices of the government also. A pictorial depiction was provided in Figure 4.6 below.

Figure 4.6: The IPM Social System in KADA



The strength of the component members' relationship with KADA could be measured by the frequency, reciprocity and intensity. From the depth interviews with the agricultural extension officers it was discovered that very little contact was made with most of the external organisations. KADA seemed to be managing their issues on their own as echoed by the officers, "***we can handle the issues by ourselves***". They did not see a real need for external assistance as the number of pest outbreaks was not rampant or serious enough. They had managed to solve their internal pest outbreak crisis quite successfully on their own.

It was discovered that most of the social system members did not have a strong relationship with KADA as it was evident from the depth interviews that their meetings to discuss collaborative IPM activities were not regular, they lacked structure and were not conducted in a formalised mode.

The exceptions were the Department of Agriculture, MARDI and the Agro-Chemical organisations. According to the agricultural extension officers, these three component members played an important role with KADA for these supportive and co-operative activities, such as;

a. Department of Agriculture - supported KADA in their pest surveillance work.

b. MARDI - helped KADA in their research and innovative work.

c. Agrochemical organisations - helped educate KADA's rice farmers on the various types of fertilisers that were developed for the eradication and control of specific pests.

A cross analysis of MADA and KADA's social system showed that MADA's social system was fabricated with a strong linkage among five of its components, whereas KADA had a strong linkage with three of its component members. In MADA, these five components members played an aggressive role in collaborative IPM activities, with the Government through the Ministry of Agriculture being the strongest one as they depended heavily for its multiple services. Through this strong linkage in the social system the members played a pertinent role in boosting the KAP of the agricultural extension officers and helped to increase their momentum on the IPM diffusion processes in both the granaries.

4. **Communication System** : A study was performed to examine if a good communication system prevailed in MADA and KADA, such that it was sufficiently aggressive to amplify the KAP of the agricultural extension officers.

MADA: When the researcher interviewed the agricultural extension officers regarding the communication system, they expressed that they "***received clear and guided instructions***" from their Head of Department on the mode of activities to be embarked. Some of the communication activities related to IPM that was undertaken included;

- the making of pamphlets regarding the rice planting schedule to be recommended to the rice farmers
- the making of posters on the life-cycle of the rice pests and also the rice field 'friends'
- the structuring of the rice field areas so as to facilitate the surveillance work of the agricultural extension officers
- the scheduling of the farmers' briefing sessions to be conducted at the Farmers' Associations
- the preparation of pamphlets regarding the steps to be endorsed as good practices of IPM which would then lead to the creation of better rice fields with higher yields
- the making of educational posters of the rice pests versus the rice field 'friends'. Examples were as depicted below in Figures 4.7 to Figure 4.9.

- Additionally, there was also the preparation of forms for the weekly and monthly reports to be completed by the agricultural extension officers on the sighting of any pest attacks in their designated area of surveillance. An example of the form was as shown below in Figure 4.10.

Figure 4.7: Types of Rice Diseases Brochures

Figure 4.8: Types of Pests in the Rice Fields of MADA and KADA

Figure 4.9: Types of Farm Friends

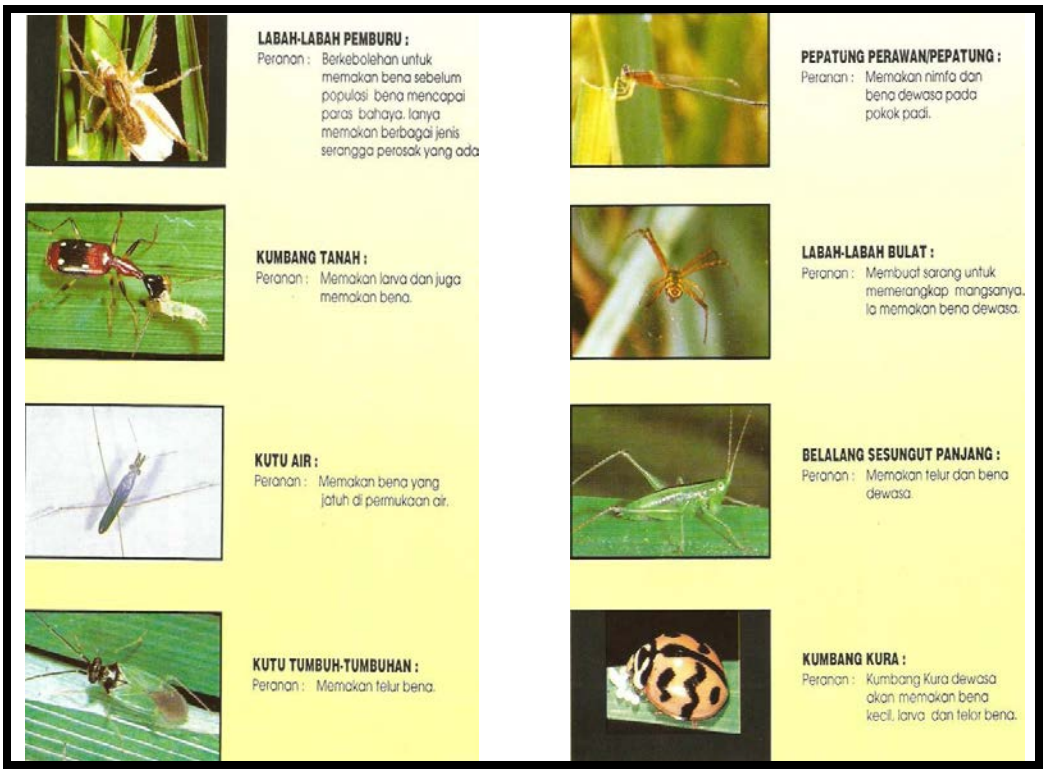


Figure 4.10: Weekly Report of Pest Attacks in MADA

PEROSAK / PPK	01 BPH	02 WBPH	03 ULAT BATANG	04 UGD	05 ULAT LAYAR	06 ULAT RATUS	07 KUTU BRUANG	08 KESING	09 KUTU TRIPS	10 TIKUS	11 HAMAMA	12 BELALANG	12a GONDAN EMAS
A1	-	-	23.00	200.10	-	-	-	-	0.29	48.15	-	-	3
A2	-	4.00	-	12.00	-	-	-	-	-	14.00	-	-	
B1	-	-	-	112.00	22.50	-	-	-	71.00	71.00	-	-	
B2	-	-	-	-	-	-	-	-	-	5.00	-	-	
C1	-	-	28.00	17.90	9.00	6.00	-	-	146.00	70.20	-	-	
C2	-	-	-	-	35.00	1.00	-	-	-	23.00	-	-	
D1	-	-	-	93.00	-	-	-	-	2.00	48.50	-	-	
E1	-	-	9.50	17.50	-	12.50	-	-	2.00	30.50	-	-	
Wilayah 1	-	4.00	60.50	452.50	66.50	19.50	-	-	221.29	310.35	-	-	3

- Moreover in MADA the system of communication maintained many pertinent reports generated on the IPM activities. These were documented through tabulations and were archived for future decision making decisions. There were reports and updated statistical documentation to support the IPM activities that were being undertaken within their area of command. Some of the collected data that were reported included the details on the level of pesticide usage. Examples of these reports were as indicated in the Figures 4.11 to Figure 4.13 below.

Figure 4.11: Types of Insecticides Used in MADA (1980-1996)

Types of insecticide	Year						
	1980	1986	1990	1992	1994	1995	1996
Gamma BHC (granulated formulation)	200	80	-	-	-	-	-
Endosulfan (granulated formulation)	280	60	15	5	4	-	-

Figure 4.12: The Distribution Level of Rodenticides in MADA (1981 – 1996)

Types of rodenticides	Year						
	Wgt	1981	1985	1990	1994	1995	1996
Zinc phosphide	Kg	2129	2255	-	-	-	-
Coumatetralyl	Kg	355	1275	-	-	-	-

Figure 4.13: Types of Herbicides Used in MADA (1980 – 1995) (in metric tons)

Types of herbicide	Year												
	1980	1983	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2,4-D IBE	100	180	250	280	250	250	200	160	150	150	150	140	145
2,4-D Sodium	50	20	NA	NA	NA	30	10	8	5	4	4	4	4

Additionally, the researcher also made an observation at the MADA extension office that most of the work seemed to be conducted by the agricultural extension officers who worked in teams. They met regularly and were seen to be busy sharing their viewpoints and discussing how best to execute their tasks. This revealed a strong 'es spirit de corp', indicating a strong sense of culture and a sturdy system of communication among them. Furthermore, with such a system in place, many of the ramifications of the new IPM innovation could be discussed with the whole team thoroughly before being disseminated by them.

As an overall observation, it could be said that the team-spirit and rapid meetings or discussions led to a strong sense of communication among the agricultural extension officers. In addition, the reports generated in MADA provided an indication that the communication system adopted was strong, as most of the critical information was recorded, made readily available and also used regularly by the agricultural extension officers as an input for future decision making.

KADA: During the researcher's visit to the extension office, it was observed that most of the agricultural extension officers had little interaction among themselves. Each of them was seen to be doing things on their own with little communication among them. The scenario exemplified strong independence among the agricultural extension officers. The Head of Department did not have very regular meetings with the agricultural extension officers but held them on an ad-hoc basis. This was indicative of a weaker communication system in KADA as compared to MADA. Contrastingly, there was regular communication flow between the agricultural extension officers and the Department of Agriculture. Regular meetings were organised between these two parties because the officers needed the Department's assistance in their surveillance work as the

Department was endowed with more facilities and equipment that facilitated such work in their rice growing localities.

In addition, the researcher made the observation that there were not many posters, pamphlets or literature on the best practices for the implementation of IPM activities being produced by the extension office at KADA. When enquired, the reply received by the researcher was that they were "***busy tending to the needs of the farmers***". Furthermore, they claimed that the rice farmers in their rice field areas were old and not too keen to learn new innovative IPM methods through printed documentation. Rather they were more receptive to the idea of listening to the explanations given by the agricultural extension officers.

With respect to the process of documentation for the statistics related to IPM implementation, such as; the level of pesticide usage, number and area of pest outbreaks, types of pests responsible for these outbreaks; there seemed to be an alarming lack of it. The Head of Department did not seem to show too much concern as he claimed the "***pest outbreaks were not significant and we can handle them***". Hence the researcher was unable to secure or even attain a glimpse of the documentation maintained at the extension office in KADA.

A cross analysis of KADA and MADA indicated that the level of communication enjoyed by the agricultural extension officers at KADA was at a much lower level than that enjoyed in MADA. Additionally, the mode of standard reports and good documentation were not strictly enforced by the Head of Department in KADA as opposed to MADA. However, according to the agricultural extension officers in KADA, the lack of it did not hamper their KAP and they were able to deploy the IPM diffusion process well to the farmers as they were able to match the

needs of their rice farmers, although the needs of the rice farmers in MADA were different. They needed to be supplied with more printed information and to hold regular interpersonal contact with the agricultural extension officers.

5. **Intermediaries' Role** : An examination was done to see whether the role of the intermediaries, the change agents (the agricultural extension officers) and the early adopters (farmer leaders) was enhanced such that they accelerated and facilitated the IPM innovation implementation process.

MADA: The depth interviews were conducted with the agricultural extension officers who also reported on their relationship with the farmer leaders or the early adopters. In the interviews, the Head commented that his subordinates "***were enthusiastic and cooperative***" towards the initiatives proposed by his department. All questions posed by the researcher were well answered by the Head and his subordinates. Regular trainings were conducted for them to understand the ramifications of the new IPM innovation, such that their confidence level was boosted. Meetings and discussions were held on a regular basis to understand these innovations and translate the new IPM research into policies and enable them to be converted into practices. New activities were designed and organised for the farmer leaders (early adopters) with the objective of upgrading their knowledge. The agricultural extension officers shared their knowledge with the farmer leaders and conducted demonstrations so as to enable them to adopt these new IPM innovations into their rice fields. Feedback from the implementation of these activities was extracted from these farmer leaders and the information gathered was then channelled to the other agricultural extension officers during their regular meetings. It was at these meetings that all the hiccups to the new IPM activities were discussed in greater depth and

summaries were drawn. These summaries were converted into reports which were then presented as papers in the conferences that were organised by the rice research authorities such as IRRI.

As a conclusion, it could be seen that the agricultural extension officers in MADA maintained a close relationship with the farmer leaders and shared with them new techniques and knowledge and also secured their critical feedback so as to enhance and accelerate the IPM innovation implementation process successfully.

With respect to the farmer leaders (early adopters), they were a group of farmers who were well respected by the other farmers in MADA. They usually held some form of leadership positions in the Farmers' Association. They also had a strong bonding to the agricultural extension officers. They held discussions with the officers regularly and sought their advice frequently regarding their rice field issues. They usually volunteered their plots of rice field as the demonstration plots. This helped to accelerate the adoption process of new IPM innovation and reduced the number of late adopters. It was also determined that by getting the farmer leaders' involvement and commitment in the projects by investing their time and money in the project, the farmers had vested interest and were more anxious to ensure project success.

KADA: From the depth interviews with the agricultural extension officers, they seemed to be "***uneasy and nonchalant***" about the questions posed regarding their role in implementing the IPM activities. They kept giving reasons that the farmers were too old and not willing to change to new methods easily. They faced an uphill battle of convincing the farmers to adopt new and more effective methods of rice cultivation through the IPM innovations.

With respect to training on the latest IPM innovation, there were few and far in between, not conducted in a formalised manner and attendance was not strictly enforced. Meetings with the other agricultural extension officers were conducted on an ad-hoc basis and based on a need-basis rather than on a strict regular schedule. This led to the adoption of the new IPM research to be conducted on a trial and error basis by the more industrious agricultural extension officers, rather than from a top-down approach imposed by the Head of Department. It was this group of agricultural extension officers who organised IPM activities with some of the farmers who were keener to learn as they had an open mindset towards new rice technology. These agricultural extension officers managed to perform a limited number of demonstration plots with this small group of interested rice farmers, who had a tough time convincing their neighbours, even with visible physical evidence.

As a conclusion, it could be seen that the agricultural extension officers in KADA could not see themselves as major change agents who could influence the rice farmer leaders or early adopters. The area of KADA and the population of rice farmers were smaller as compared to MADA. The age of the rice farmers was also more advanced and their mindset was more closed towards innovation and new technology as compared to the rice farmers from MADA. Only a small number of agricultural extension officers were keen to keep a close relationship with the more enthusiastic rice farmers and shared with them new methods and technology which helped to enhance their knowledge on the latest IPM innovations.

With respect to the farmer leaders or early adopters, the scenario in KADA was very different from MADA. Here the number of enthusiastic farmer leaders was minimal. Hence only this group was keen to form a close relationship with the agricultural extension officers and learn

from them any new technology that would aid them in improving their rice productivity. They also sought advice from the officers on how to address the issues encountered by them at their rice fields. Only they would attempt to do the demonstration plot but they were unable to arrest the number of late adopters.

6. **Innovation Attributes** : An investigation was conducted to determine if the attributes of the innovation assisted in improving the process of facilitating the smooth diffusion process of IPM.

According to the theory, there were five attributes of an innovation that would facilitate the smooth diffusion of the innovation, viz.,

- Trialability – the innovation can be tested or experimented
- Observability – the results from using the innovation are visible
- Relative Advantage – the innovation was perceived better that the old technology in terms of easier usage, increase in revenue or reduction in costs, etc
- Simplicity – the innovation was simple to understand and new skills were not required to utilise or adopt it
- Compatibility – the innovation fits in with currently used methods

MADA: From the depth interviews, the agricultural extension officers explained that they were proud to have been able to influence the farmer leaders (early adopters) to test out new IPM innovation on their rice plots as a demonstration plot for others to see. One example was the

animal and fish husbandry in their rice fields. This IPM activity of rearing the animals (ducks) and fish was to eliminate the breeding of certain pests. These pests would become the food for these animals as well as double up as a supplementary source of income from the sale of these fully grown animals. With reference to the five attributes of an innovation, all of them were fulfilled by this new IPM activity endorsed by the agricultural extension officers. The animal and fish husbandry was easy to test out, the results could be observed easily, it proved its relative advantage to the farmers, it did not require additional new skills and hence had low complexity and finally was compatible to their current method of production.

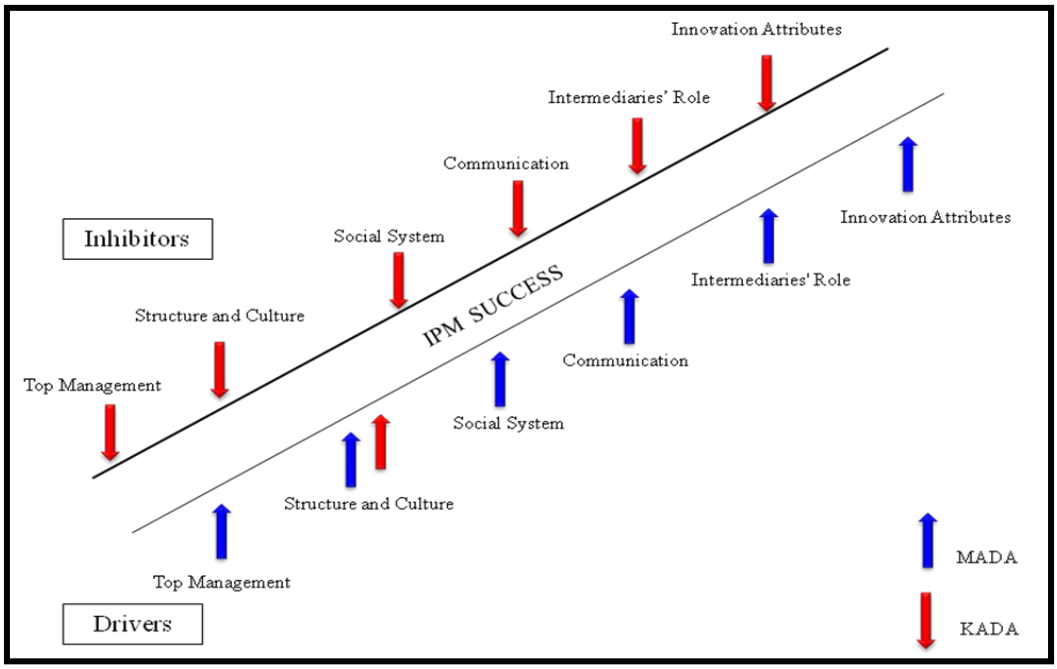
The conclusion that could be drawn was that with the sanction of the rice farmers, the agricultural extension officers had little difficulty on encouraging new IPM innovation as the farmers were educated to a level of accepting the benefits of the new IPM innovation and did not see it as an encumbrance rather as a stimulator to their rice productivity levels.

KADA: The agricultural extension officers carried out certain activities to promote the adoption of new IPM innovations. However, their results were not very enthusiastic as they claimed that the farmers were not too keen to learn new technology as they could not appreciate the need for such new IPM innovations. According to the agricultural extension officers, they found only a minimal number of rice farmers keen on rearing the fish and animals on their rice fields. Many of the farmers were too old to attempt new IPM activities or felt it was too much of a nuisance to undertake these activities, despite seeing its workability or success among their neighbour farmers. They felt that everything on the rice farms was in status-quo and felt that change was not warranted.

As a conclusion, it could be witnessed in KADA that the attitude of the rice farmers signified a major hindrance to the enhancement or acceleration of the IPM diffusion process for new innovations, despite the IPM innovations being testable, observable, having extrinsic relative advantage, were not complex and were compatible to their current agenda of activities on the rice farms.

As a summary on the findings, below in Figure 4.14 is a pictorial description of the key variables that proved to be a driver or an inhibitor to both MADA and KADA.

Figure 4.14: IPM Success : Drivers and Inhibitors



Additionally, there was one last question in the questionnaire that requested the opinion of the Heads of Department with respect to the key hindrances to the successful implementation of IPM in their respective rice granaries. Some of their responses included;

MADA: In MADA, the agricultural extension officers at the 27 localities wore '2' hats, which led to a conflict of interests and division of time. Besides undertaking their extension work, the agricultural extension officers kept themselves busy with the work of the Farmers Association. The latter work was rewarded with bonuses when the Farmers Associations managed to reap great returns from prudent and wise investment decisions. Hence there was a bias of the agricultural extension officers to slacken their extension duties and concentrate more on their Farmers Association work.

- Although many of the farmers had knowledge about IPM, they were however not confident with IPM because IPM could not prevent losses due to pests attacks which would consequently reduce their yield and also their income. Therefore they did not want to take the risk of loss from yield or income.

- Agro-chemical organisations had a mandate of making sales of all authorised pesticides. They also acted as a strong influencing factor to the rice farmers, encouraging them to purchase pesticides which would help to eliminate their pest problems.
- There were many shops which sold illegal pesticides to the farmers. These illegal pesticides were smuggled in from Thailand and were of the broad spectrum quality. These were much cheaper than the specific spectrum pesticides sold at the Farmers' Association offices. Furthermore, these shops were closer to the farmers' fields and facilitated faster purchases to be made by the farmers.

KADA

- According to the feedback from the agricultural extension officers, most of the farmers were less educated and of a more advanced age. This made them slower in picking up the new IPM technology and innovation when it was explained to them.

- Farmers generally wanted quick fixes to their problems before the pests damaged their yield and made them incur high losses. The farmers could not wait for the economic threshold level before taking action as some of their crops would have to be sacrificed in the process.

From the questions posed to the Heads of Department at both MADA and KADA, it was discovered as stated above, that there were some obstacles placed in the path of the smooth implementation of the new IPM technology and innovation, at both the granaries.

In 2007, a re-visit was made by the researcher to the two rice granaries of MADA and KADA, after the initial research was conducted in the year 2001. The objectives of the re-visit were as follows;

1. To report on the recent developments with respect to the IPM activities of the agricultural extension officers and the extension departments of both the rice granaries.
2. To conduct a review of the six key variables of the exploratory framework, to determine if their presence was a driver of the success of IPM diffusion or were they absent, thus rendering them to be inhibitors to the success of IPM technology and innovation adoption.

The research tool used was Part I of the questionnaire, the same one that was used in the research done in 2001. The respondents for this part of the research were the Heads of Department in MADA and in KADA.

The issues that were researched were the six key variables;

1. **The Role of Top Management** : Was there any significant change in the role of top management in both the granaries over the years 2001 till 2007 ?

MADA: The new Head of Department shared that the department continued its set vision of propagating IPM which had been in practice for many years. Although the granary received funds from the government, the amount was insufficient. Hence this led the extension department to devise new ways that ensured new streams of income to be generated to self-finance some of their projects and activities. Some of these newly created activities included; the rearing of poultry and fish to augment the income stream of the rice farmers and earned indirect income for MADA.

Additionally, the role of MADA rose in significance over the years as they were requested to make weekly reports to the Ministry to help validate the Ministry's decision as to whether rice should be imported into Malaysia or not. These reports elevated MADA's status as being one of the key providers of input to the government. The top management were goaded into exhibiting high levels of commitment. They played out their role of providing a system of rewards and motivation to the agricultural extension officers and their teams. The weekly/monthly reports also provided a feedback mechanism of checking and presented an estimation or indicator of how successful IPM practices were implemented by the end-users, the rice farmers, with the support and assistance from these agricultural extension officers.

Overall it could be concluded that the role of top management with respect to resources, leadership and commitment were still maintained at a high level over the period of study. The top management felt even more committed as they saw they played an important role in the nation's decision making process regarding rice imports.

KADA: According to the interview with the new Head of Department, he claimed that the top management of KADA had a vision of IPM which they strongly endorsed. Their commitment was translated into a series of activities that focussed on the new IPM innovations. One of the key tenets of their IPM vision was to reduce the amount of pesticides that were being sprayed by the rice farmers, which was done according to the calendar months and this was inadvertently destroying the environment. The top management undertook efforts to instil a prudent usage of the pesticides to a level where it was critical. They upheld a vision of the long-term benefits on the environment and to the farmers' health. They encouraged farmers to not just focus on 'quick fixes' for their current pest problems but rather take a longer view of their living environment and the land in which they were cultivating their crops.

Other initiatives endorsed by the top management included their effort to strongly encourage the rice farmers to participate in formalised meetings which were organised by the Farmers' Association. Top management ensured the preparation of amenities such as reserved coaches to transport the rice farmers from their dwellings to the rented hall premises, where the latest IPM innovations were explained and shared with the rice farmers, to secure their buy-in.

Besides these endeavours, the top management also arranged informal meetings between the agricultural extension officers and the key leaders of the rice farmers, to introduce the new IPM

innovations and research findings. This revealed a strong sense of leadership and also their high level of commitment to the successful implementation of IPM.

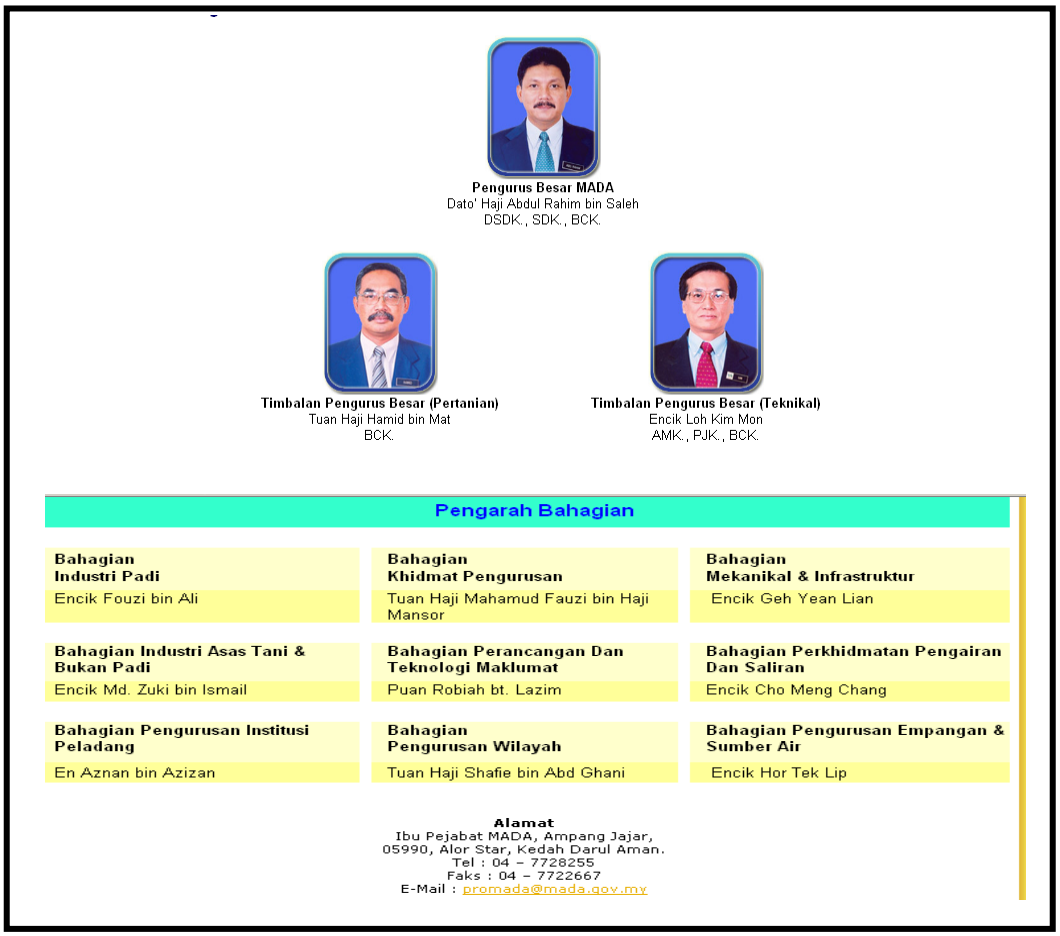
With respect to the financial aspect, the top management in KADA relayed that they were provided with an allocation from the government through the 9th Malaysian Plan. This was also in accordance to the working paper which was presented to the government for the appropriate budget allocation. All endeavours for IPM and other agricultural good-housekeeping activities depended heavily on the budget provided to them. They lamented that although the amount allocated to KADA from the government was insufficient, they endeavoured to undertake activities to support the rice farmers and the implementation of IPM activities within the budget allocation.

Overall, it could be seen that there was a huge difference in the attitude of the new top management in KADA with respect to the IPM activities, as compared with the earlier interview conducted in the year 2001. Their leadership style was more focussed towards IPM and their level of commitment to make IPM a success was seen as more aggressive. They even worked positively around the prevalent resources and provided encouragement to the rice farmers trapped within the budget constraints.

2. **<u>Structure and Culture</u>** : Was there any significant change in the structure and culture in both the granaries over the years 2001 till 2007 ?

<u>MADA:</u> Being an entity of the government, the structural changes were practically non-existent. All the prevalent bureaucratic structure was maintained over the time period of research. The organisation chart was kept intact with the key personnel being replaced once they had retired from the government service. The current organisation chart was as shown in Figure 4.15 below.

Figure 4.15: MADA Organisation Chart



Over the time period, MADA was fortunate to have part of its structure augmented as they managed to secure support from the Government and some international organisations. MADA received additional facilities and some of their existing facilities were upgraded to meet the increasing requirements of the plant protection activities strongly endorsed by IPM research and innovation. Some of the augmented facilities were;

- Laboratories and experiment sites (e.g. pesticide quality and residue analysis laboratory, plant quarantine laboratory) were equipped with basic facilities

- Laboratories received additional imported technology that aided them in their process of transferring the latest IPM research and innovation into actual initiatives for the rice farmers to use in their rice fields

- Many district and cooperative offices were provided with vehicles and devices for pest surveillance and forecast, all of which were under the umbrella of the extension activities at the regional plant protection centres

With respect to the issue of culture, there seemed to be the air of continuity for the propagation of IPM activities. The agricultural extension officers were still strongly attuned to this culture which was set by their previous bosses. Their endeavour towards instilling good IPM practices among the rice farmers was still strong. Furthermore, it was discovered from the subsequent interview with the Head of Department, that the agricultural extension officers' focus on IPM had evolved to providing supplementary support to the rice farmers, rather than undertaking direct

IPM intervention which was their ‘modus operandi’ in the year 2001 when the initial interviews were conducted. The main reason being that the rice farmers within their jurisdiction were fairly educated on IPM practices, possessed sufficient IPM knowledge and they endorsed the necessary attitude to endorse the IPM practices effectively.

Overall, it could be seen that the structure at MADA was still maintained along similar lines with some enhancement with respect to facilities, while the culture had matured to a higher level of support rather than direct intervention by the agricultural extension officers.

KADA: Likewise with MADA, KADA also experienced minimal structural changes as it was part of the government body. Most of the existing structure was maintained over the time period of the research. The current organisation chart was as shown in Figure 4.16.

Figure 4.16: KADA Organisation Chart

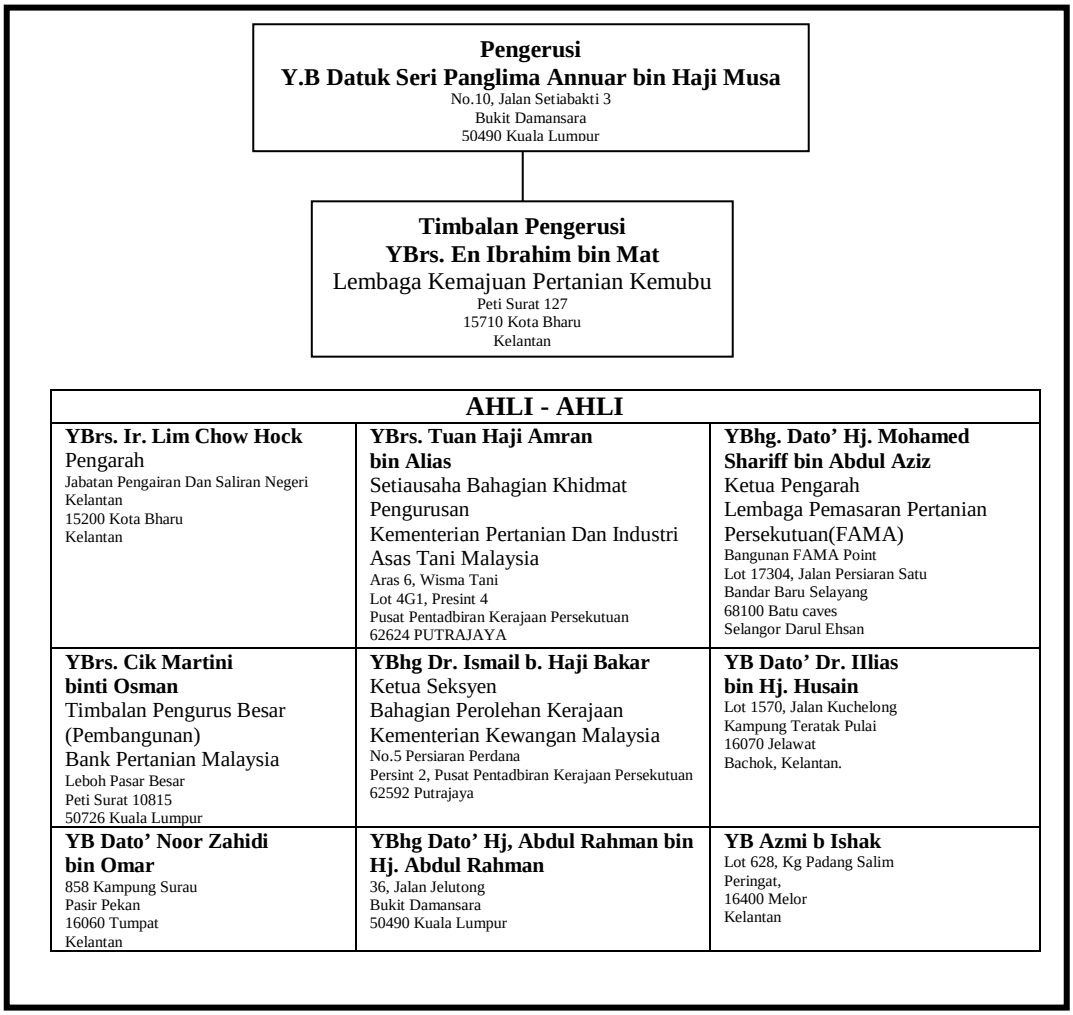
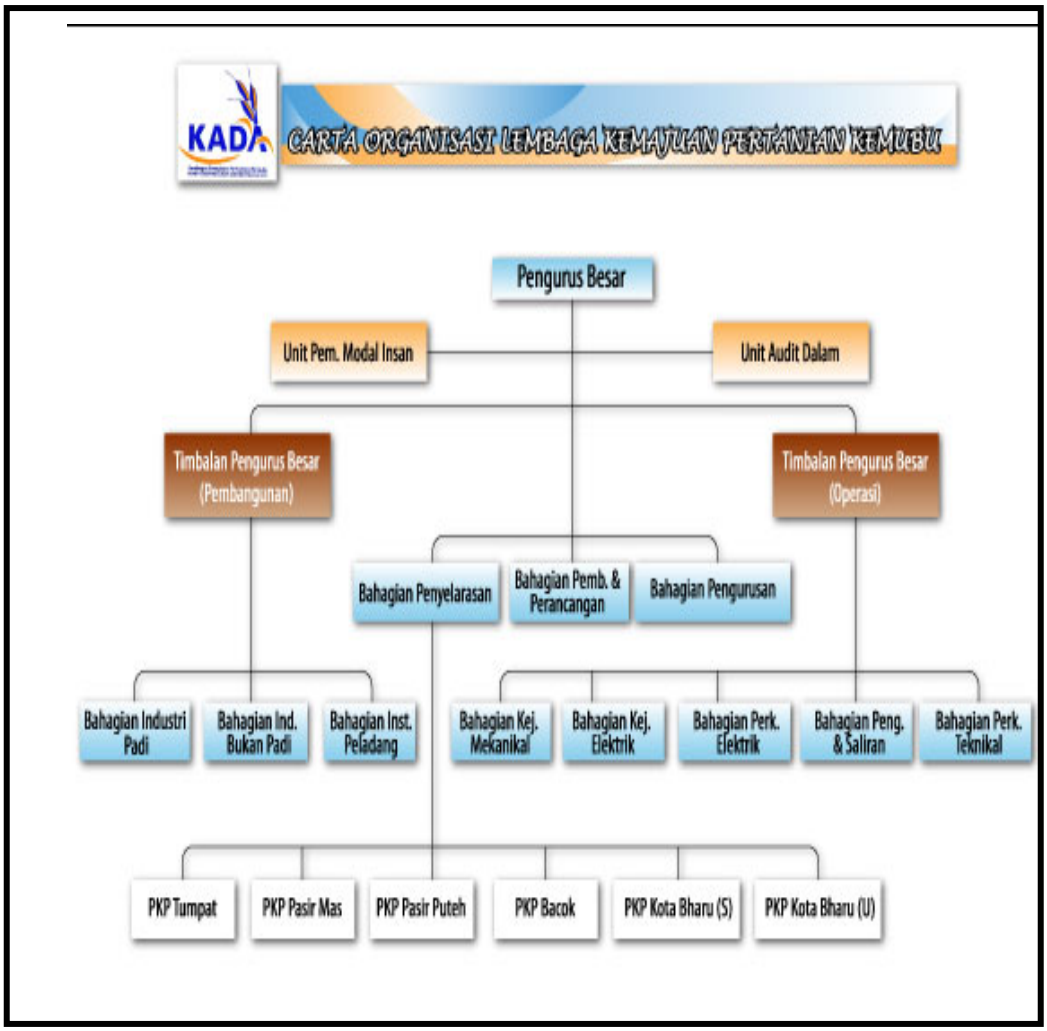


Figure 4.17: KADA Organisation Chart



From the subsequent interview, it was observed that the structure was maintained while the culture had taken a transformation with greater IPM intervention and endorsement by the top management and distilled to the extension officers. However, all the IPM initiatives faced a barrier in the form of reluctance and non-support from the end-users, viz., the rice farmers themselves. Some of the various reasons were;

- Their advanced age factor: they have been used to doing things in a certain way and were reluctant to adapt to the new innovations as recommended by IPM
- Their lower income level was a major deterrent to them adopting the IPM which they felt was too costly and may jeopardise their income levels
- They also felt the procedures when adopting IPM innovation were too tedious and time consuming and they wanted a shorter and uncomplicated method of managing the pests

- They also felt that their current method of managing the pests through the use of cheap toxic pesticides were more than sufficient

- They also felt that the government and KADA authority should bear any additional switching costs to IPM innovation practices. Examples included; the costs of rearing of owls or the purchase and placing of lights to deter the rodents' pest problem. They believed that the government should foot the bill for all these new IPM initiatives

To overcome this, the top management together with the Ministry of Agriculture decided to embark on a scheme that would alleviate the shortcomings of the rice farmers in the KADA area. This project was named "LADANG MERDEKA". The Merdeka Farm Concept was a large scale farm management commercial concept where farm lands were designed to a suitable size using high technology techniques. It was hoped that a model of "farm development" would change the non-systematic working culture into a culture that paid greater attention to the latest innovation in estate management to achieve higher productivity.

This concept was implemented in 1991 with 5 farms of 211.78 hectors. By December 2005, 17 farms of 749.76 hector were involved.

The key objectives of the Merdeka Farm were; making use of the unattended rice fields, giving independence to the rice field owners and increasing the operational productivity of the rice fields through. This was done through;

- estate management
- the use of direct labour in a well-organised and efficient way
- the use of machines as the farm mechanism
- the use of correct farming input to save operational costs

The Merdeka Farm had 3 key phases namely;

- Phase I : Social Engineering

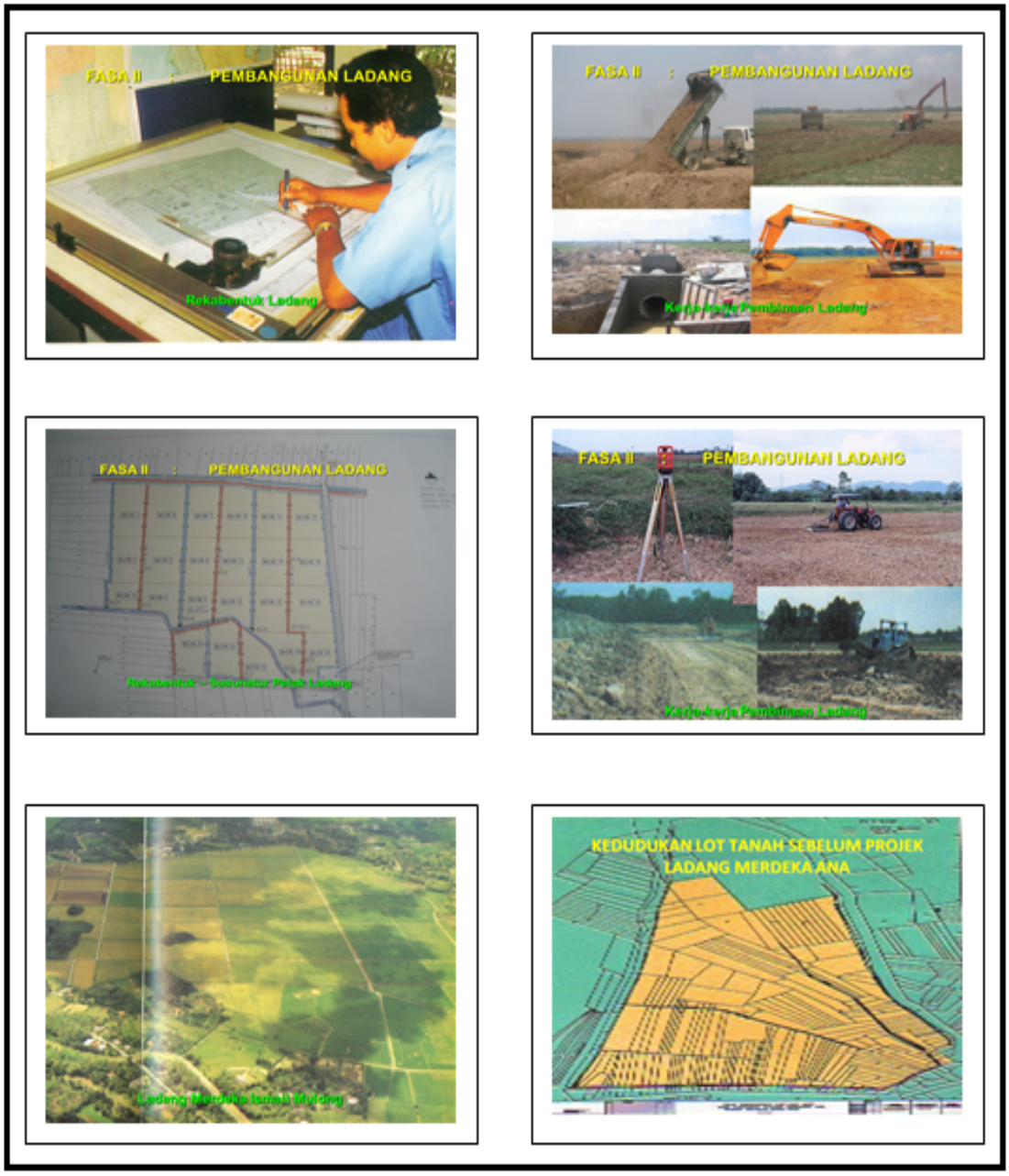
In this phase, the locations were identified and this was followed with meetings with the land owner to secure their approval leading to the agreement being signed by both parties.

Figure 4.18: Phase I Social Engineering

- Phase II : Estate Development & Infrastructure

In this phase, the infrastructure and the estate route were designed and constructed.

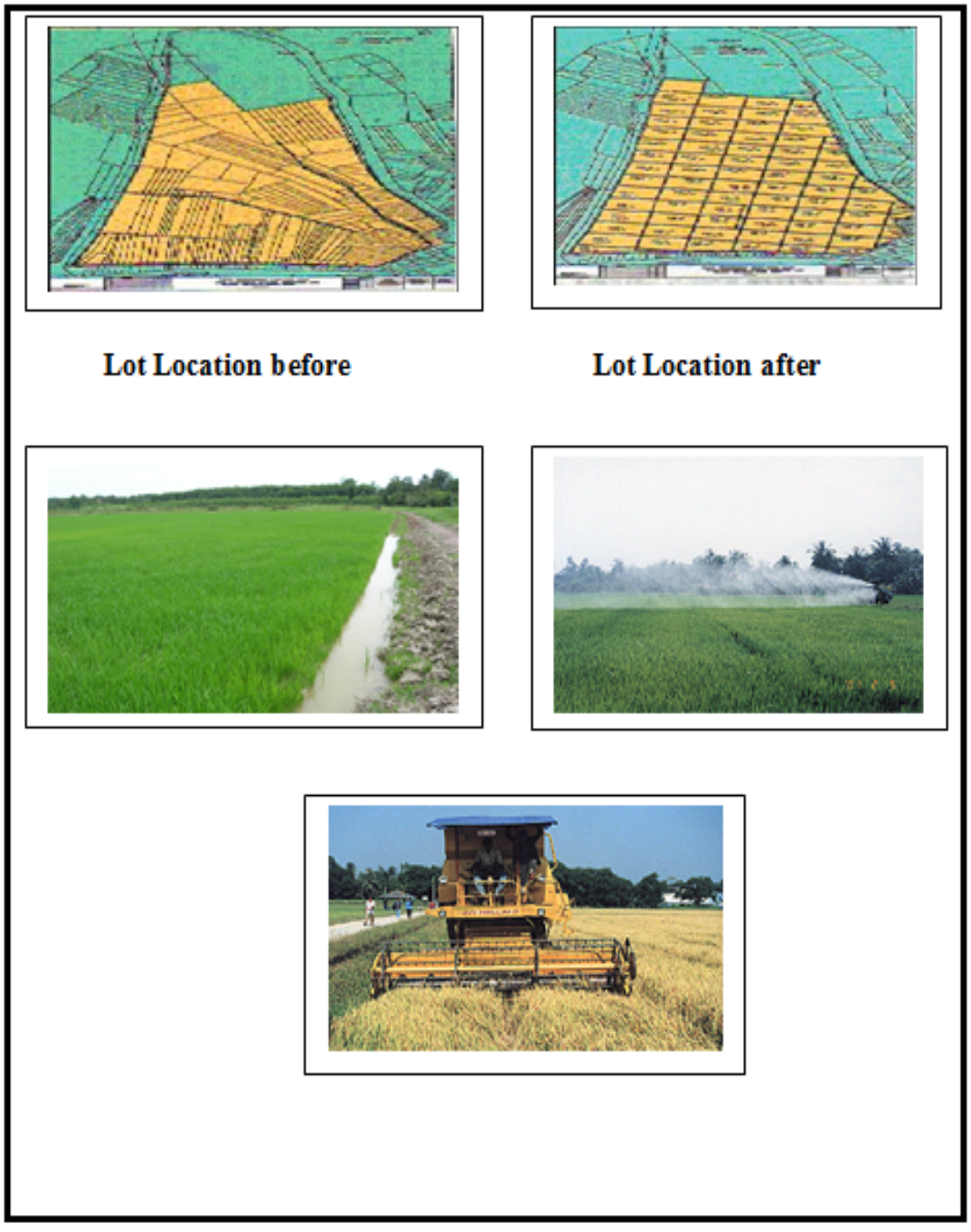
Figure 4.19: Phase II Estate Development & Infrastructure



- Phase III : Estate Management

In this phase the planting, harvesting, productivity and marketing were planned and executed. An example of how the rice fields would be before and after the estate management was displayed below.

Figure 4.20: Phase III Estate Management



Some of the benefits that had been experienced by the Merdeka Farm were the reaping of a Net Profit of RM 2,566.12/Hector/Ton, which represented an increase in the profits of the rice farmers by 20%. Other benefits included; an increase in productivity, an increase in land value and the development of infrastructure in that region.

Overall it could be witnessed that top management were committed to ensure a higher productivity level for the rice farmers. Despite the barriers created by the farmers, more aggressive action was taken, for example, the Merdeka Farm project, which resulted in high yields per hectare for KADA.

3. **Social System** : Was there any significant change in the social system in both the granaries over the years 2001 till 2007 ?

MADA : From the interview with the Head of Department, it was revealed that there was continuous contact with most of the members of the prevalent social system with one new notable addition, the Malaysian Centre for Remote Sensing (MACRES). This component aided with their expertise to MADA's surveillance endeavour of controlling the pest outbreaks in their area of rice cultivation. Additionally, the government continued to prove to be the strongest link as it continued to provide access to expertise, technology, laboratories, research facilities and financing. Additionally, this strength was also evidenced by the meetings with the Ministry of Agriculture which was conducted on a regular bi-weekly basis as the Ministry needed MADA's input to substantiate their decision on whether to import or not to import rice grains from overseas.

Overall, there was no significant change with the exception of the strengthening of the role of the government in the social system of MADA.

KADA : From the interview held, there was no significant change in the social system, either from the aspect of new membership or changes in the role played by the prevalent members.

4. Communication System : Was there any significant change in the communication system in both the granaries over the years 2001 till 2007 ?

MADA: Most of the components of the communication system that had been witnessed at the initial meeting in 2001 were seen to be maintained when the review meeting was conducted in 2007. However, there was an upgrade in some aspects of the communication system in operation at MADA. For example, MADA developed a real-time Management Information System (MIS) to optimise the efficient use of its water resources and to plan the irrigation schedules so as to take into consideration the maximum utilisation of rainfall. The optimisation of the usage of a finite and vulnerable water resource was a complex task that required accurate and timely assessment of the supply and demand situations. Hence the MIS could acquire and process automatically large quantities of data that were needed to support operational decisions, while simultaneously, it accumulated information vital for performance evaluation and developing planning.

The MIS comprised of; a main frame computer that did all the data processing and was the central repository, 73 telemetric rainfall stations which were distributed over the entire cultivated area and the reservoir catchments, a total of 11 stations equipped with telemetric water level

recorders, computer terminals at the four MADA administrative districts and a well-linked communication network made of VHF radio channels, transceivers, telephone and tele-fax facilities.

Through the MIS, MADA was able to introduce appropriate operational changes which had contributed to significant performance gains such as; cropping intensity, water productivity, communication efficiency, better water allocation strategy, faster response to field conditions and an enhancement in rice production.

Overall, the communication system in MADA had progressed by leaps and bounds and aided in their planning, monitoring and development stages of the rice crop exponentially.

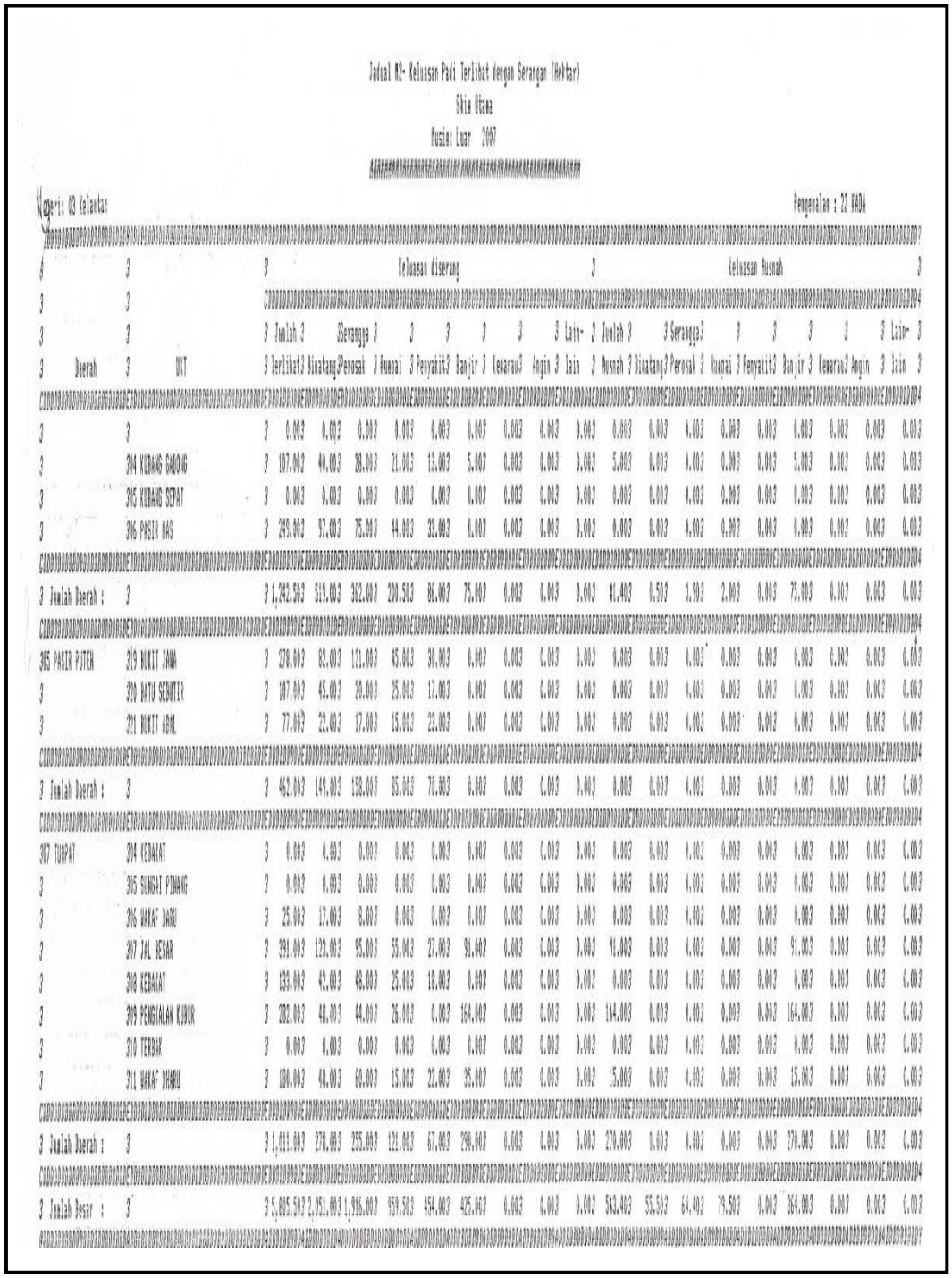
KADA : The interview with the Head of Department indicated that much improvement was made in the communication system in KADA, such as; monthly meetings were held to garner feedback from each of the agricultural extension officers with respect to the pest outbreak levels. These regular meetings helped to enhance the level of communication and facilitated smooth and effective action to be taken by the extension office and the agricultural extension officers when a pest outbreak happens. Additionally, monthly reports were compiled and assimilated into a yearly report for both the main season and secondary season. Examples of these were depicted in Figure 4.21, Figure 4.22 and Figure 4.23below.

Figure 4.21: KADA Monthly Report

From 07/05/2008 to 21/06/2008
Season : 1 / 2008

PEROSAK / PPK	01 BPH	02 WBPH	03 ULAT BATANG	04 UGD	05 ULAT LAYAR	06 ULAT RATUS	07 KUTU BRUANG	08. KESING	09 KUTU TRIPS	10 TIKUS	11 HAMAMA	12 BELALANG	12a GONDA EMAS
A1	-	-	23.00	200.10	-	-	-	-	0.29	48.15	-	-	3
A2	-	4.00	-	12.00	-	-	-	-	-	14.00	-	-	
B1	-	-	-	112.00	22.50	-	-	-	71.00	71.00	-	-	
B2	-	-	-	-	-	-	-	-	-	5.00	-	-	
C1	-	-	28.00	17.90	9.00	6.00	-	-	146.00	70.20	-	-	
C2	-	-	-	-	35.00	1.00	-	-	-	23.00	-	-	
D1	-	-	-	93.00	-	-	-	-	2.00	48.50	-	-	
E1	-	-	9.50	17.50	-	12.50	-	-	2.00	30.50	-	-	
Wilayah 1	**-**	**4.00**	**60.50**	**452.50**	**66.50**	**19.50**	**-**	**-**	**221.29**	**310.35**	**-**	**-**	**3**
A2	-	-	-	37.60	-	-	-	-	-	50.50	-	-	
B2	-	-	-	5.00	-	-	-	-	5.00	145.80	-	-	26
C2	-	-	-	-	69.00	-	-	-	-	46.00	-	-	47
D2	-	-	4.50	2.00	-	-	-	-	-	44.50	-	-	
E2	-	-	40.05	58.65	-	-	-	-	81.95	145.80	-	-	
F2	-	18.00	-	54.00	18.00	-	-	-	18.00	18.00	-	-	35
G2	-	-	-	-	-	-	-	-	1.20	117.00	-	-	
H2	-	-	-	18.70	16.70	-	-	-	-	74.20	-	-	
I2	-	-	-	2.00	10.00	11.50	-	-	-	36.00	-	-	
Wilayah 2	**-**	**18.00**	**44.55**	**177.95**	**113.70**	**11.50**	**-**	**-**	**106.15**	**677.80**	**-**	**-**	**106**
B3	-	-	-	-	-	-	-	-	-	-	-	-	1
D3	-	-	-	-	-	-	-	-	-	748.00	-	-	589
E3	-	-	-	-	-	-	-	10.00	9.50	27.55	-	-	
F3	-	-	3.00	6.50	-	-	-	-	-	112.00	-	-	21
Wilayah 3	**-**	**-**	**3.00**	**6.50**	**-**	**-**	**-**	**10.00**	**9.50**	**887.55**	**-**	**-**	**612**
B4	-	-	-	-	-	-	-	-	-	282.00	-	-	262
C4	-	-	-	12.00	4.00	-	-	-	-	29.00	-	-	
F4	-	-	-	-	-	-	-	-	-	25.70	-	-	248
G4	-	-	-	45.40	-	-	-	-	-	51.60	-	-	
Wilayah 4	**-**	**-**	**-**	**57.40**	**4.00**	**-**	**-**	**-**	**-**	**388.30**	**-**	**-**	**510**
JUMLAH	**-**	**22.00**	**108.05**	**694.35**	**184.20**	**31.00**	**-**	**10.00**	**336.94**	**2,264.00**	**-**	**-**	**1,234**

Figure 4.22: KADA Yearly Pest Attack Levels : Main Season



Jadual R2- Keluasan Padi Terlibat dengan Serangan (Hektar)

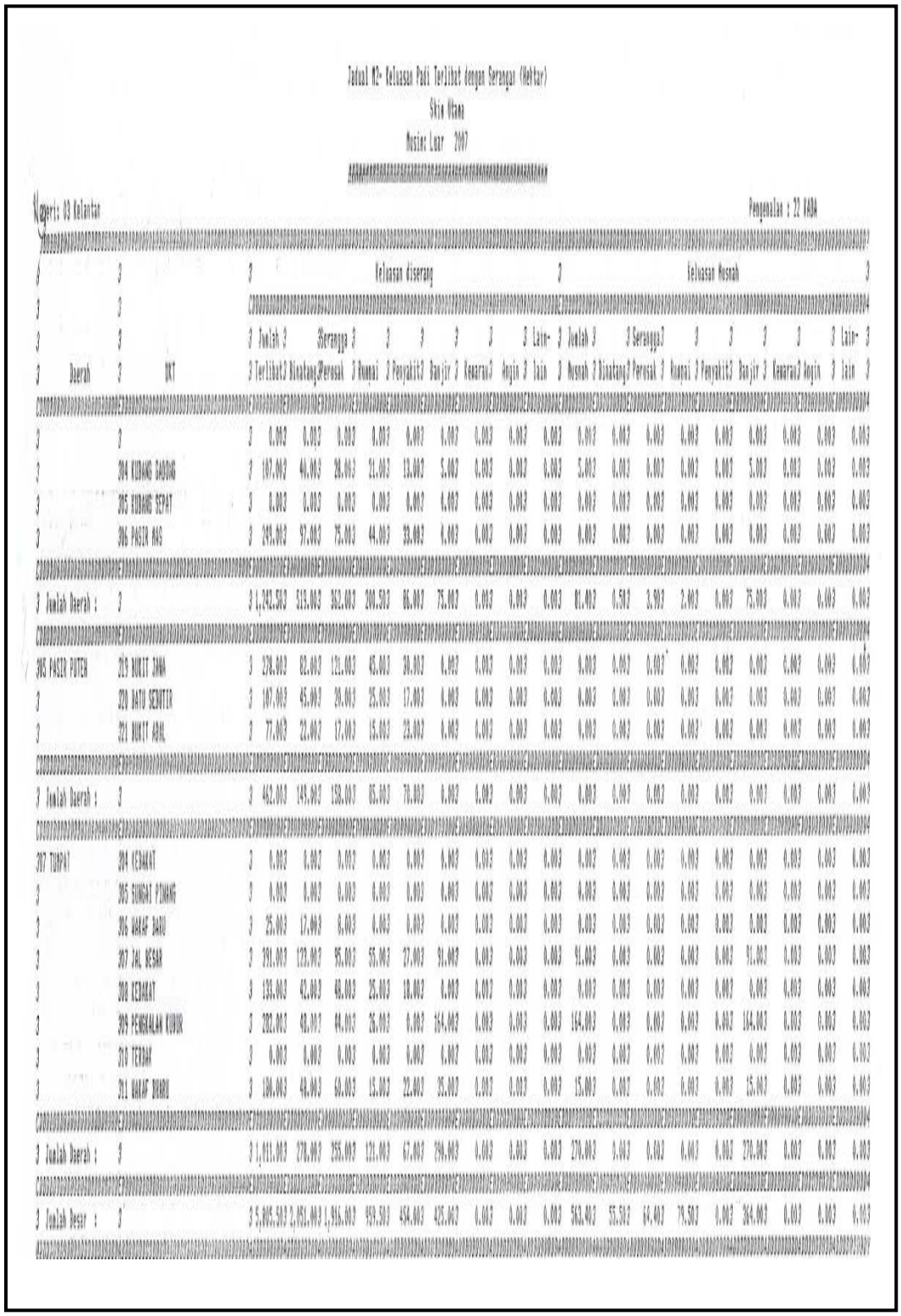
Skim Utama

Musim Luar 2007

Negeri: 03 Kelantan — Penyemaian : 22 KADA

Daerah	MK	Kelusan diserang: Jumlah	Serangga	Binatang	Perosak	Kumpai	Penyakit	Banjir	Kemarau	Angin	Lain-lain	Kelusan Musnah: Jumlah	Serangga	Binatang	Perosak	Kumpai	Penyakit	Banjir	Kemarau	Angin	Lain-lain
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	204 KEDAING GADONG	197.00	46.00	28.00	21.00	13.00	5.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
	205 KEDAING SEPAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	206 PASIR MAS	249.00	97.00	75.00	44.00	33.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jumlah Daerah :		1,245.50	515.00	362.00	280.50	86.00	75.00	0.00	0.00	0.00	81.40	0.50	3.50	2.00	0.00	75.00	0.00	0.00	0.00	0.00	0.00
PASIR PUTEH	219 BUKIT JAWA	278.00	82.00	121.00	45.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	220 BATU SEMANTIR	107.00	45.00	20.00	25.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	221 BUKIT ABAL	77.00	22.00	17.00	15.00	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jumlah Daerah :		462.00	149.00	158.00	85.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TUMPAT	204 KEDAWAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	205 SUNGAI PINANG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	206 WAKAF BARU	25.00	12.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	207 JAL BESAR	391.00	122.00	95.00	55.00	27.00	91.00	0.00	0.00	0.00	91.00	0.00	0.00	0.00	0.00	91.00	0.00	0.00	0.00	0.00	0.00
	208 KEDAWAT	135.00	42.00	48.00	25.00	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	209 PENDAKALAN KUBOR	282.00	48.00	44.00	26.00	0.00	164.00	0.00	0.00	0.00	164.00	0.00	0.00	0.00	0.00	164.00	0.00	0.00	0.00	0.00	0.00
	210 TEPASU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	211 WAKAF BARU	186.00	48.00	60.00	15.00	22.00	25.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00
Jumlah Daerah :		1,011.00	278.00	255.00	121.00	67.00	290.00	0.00	0.00	0.00	270.00	0.00	0.00	0.00	0.00	270.00	0.00	0.00	0.00	0.00	0.00
Jumlah Besar :		5,805.50	2,051.00	1,916.00	959.50	454.00	425.00	0.00	0.00	0.00	363.40	55.50	64.00	79.50	0.00	364.00	0.00	0.00	0.00	0.00	0.00

Figure 4.23: KADA Yearly Pest Attack Levels : Second Season



Jadual M2- Keluasan Padi Terlibat dengan Serangan (Hektar)
Skim Utama
Musim: Luar 2007

Negeri: 03 Kelantan — Pengesahan : 22 KADA

Daerah	MK	Keluasan diserang								Keluasan Rosak							
		Jumlah Terlibat	Serangga Binatang	Perosak	Penyakit	Banjir	Kemarau	Angin	Lain-lain	Jumlah Rosak	Serangga Binatang	Perosak	Penyakit	Banjir	Kemarau	Angin	Lain-lain
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	204 KUBANG DADONG	107.00	40.00	28.00	21.00	13.00	5.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
	205 KUBANG SEPAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	206 PASIR HAS	295.00	97.00	75.00	44.00	33.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jumlah Daerah :	2	1,242.50	515.00	362.00	200.50	86.00	75.00	0.00	0.00	81.00	0.50	3.00	2.00	0.00	75.00	0.00	0.00
208 PASIR PUTEH	219 BUKIT JAWA	178.00	82.00	121.00	45.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	220 BATU SEMUTIR	107.00	45.00	29.00	25.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	221 BUKIT ABAL	77.00	22.00	17.00	15.00	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jumlah Daerah :	2	452.00	149.00	138.00	85.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
207 TUMPAT	204 KEDAWAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	205 KUBANG PINANG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	206 KAKAP BARU	25.00	17.00	8.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	207 JAL BESAR	291.00	123.00	95.00	55.00	27.00	91.00	0.00	0.00	91.00	0.00	0.00	0.00	0.00	91.00	0.00	0.00
	208 KEDAWAT	135.00	42.00	48.00	25.00	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	209 PENGKALAN KUBOR	282.00	48.00	44.00	26.00	0.00	164.00	0.00	0.00	164.00	0.00	0.00	0.00	0.00	164.00	0.00	0.00
	210 TEPIAH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	211 KAKAP BHARU	186.00	48.00	60.00	15.00	22.00	25.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00
Jumlah Daerah :	7	1,911.00	278.00	255.00	121.00	67.00	796.00	0.00	0.00	270.00	0.00	0.00	0.00	0.00	270.00	0.00	0.00
Jumlah Besar :	9	5,805.50	2,951.00	1,916.00	959.50	454.00	425.00	0.00	0.00	563.00	55.50	64.00	79.50	0.00	564.00	0.00	0.00

Reports such as these provided invaluable information and formed the key means of communication between all the various localities and agricultural extension officers. Besides that, effort was made to disseminate IPM technology through various means of communication to the rice farmers. Some of these methods included the usage of radio announcements, preparation and printing of bulletins and brochures.

Overall, it could be witnessed that the level of communication in KADA had catapulted to a new level and instigated a more supportive response from the agricultural extension officers there, which indicated a continued strive for an improvement in communication with the rice farmers.

5. **Intermediaries' Role** : Was there any significant change in the intermediaries' role in both the granaries over the years 2001 till 2007 ?

MADA : From the depth interview, it was discovered that many activities were performed by the agricultural extension officers to ensure that the rate of adoption of new innovation was enhanced among the rice farmers. One of the activities done was working on 'demo-plots' for farmers to have physical evidence of success and to increase their faith that the new IPM innovation was logistically possible. Once they observed the viability of the new innovation and appreciated its relative advantage, then adoption of the innovation did not appear to be complex, rather compatible to their current farm activities. This improved the success of adoption of the new IPM innovation among the rice farmers.

Additionally, to augment their position as advisors to the rice farmers, the agricultural extension officers participated in national and overseas conferences, workshops and seminars in plant protection, where knowledge and experiences with respect to plant protection were exchanged.

Further, information was secured that identified the number of training programs that were conducted by the agricultural extension officers for the rice farmers as part of their educational activities. Tables 4.1 and 4.2 below, represented the different types of training programs conducted, together with some additional information on the number of participants for each of the training program for the years 2004, 2005 and 2006.

Table 4.1: MADA- 2004 : Types of Training Programs, Number of Trainings and Number of Participants

Training Courses	Number	Number of Participants
1. Technology to improve rice productivity	**50**	**1488**
2. Workshop 10 ton	**5**	**1250**
3. Campaign Pest Control and Rice Diseases	**120**	**3621**
4. Entrepreneur Training	**5**	**379**
5. Business and Accounts Management	**2**	**60**
6. Pest Control skills	**2**	**51**
7. Transformation	**2**	**120**
8. Motivation and People Development	**2**	**120**
TOTAL	**188**	**7089**

Table 4.2: MADA-2005 : Types of Training Programs,
Number of Trainings and Number of Participants

Training Courses	Number	Number of Participants
1. Technology to improve rice productivity	**12**	**675**
2. Entrepreneurship	**11**	**389**
3. Prospective Technology	**1**	**2**
4. Visits	**2**	**72**
5. Poverty Development Program	**3**	**74**
6. Cooperative - Basic Planting Skills	**4**	**246**
TOTAL	**33**	**1458**

From the above two tables, there was evidence of extensive trainings for the rice farmers although there was a notable reduction in the year 2005. The reason could be the extensive floods that could have washed out the plans for having such trainings.

Moreover, in Tables 4.3 and 4.4 below, an indiction was provided as to the types of training programs, the frequency as well as the number of participants for both categories, viz., the officers (Table 4.3) as well as the rice farmers (Table 4.4), for the year 2006.

Table 4.3: MADA-2006 : Types of Training Programs,
Number of Trainings and Number of Participants (Officers)

Training Courses for Agricultural extension officers	Number	Number of Participants
1. Administration and Management	10	529
2. Motivation and Personal Development	7	344
3. Computer and IT Skills	31	500
4. Rice Yield Productivity Technology	20	441
5. Water Management and Engineering	12	308
6. Entrepreneurship and Skills Training	7	247
7. Accounts Management	9	137
8. Rice Fertiliser Subsidy Briefing	1	60
9. Conference/Workshop/Talk	10	677
10. Visit for Farm Day/Study Visit	2	202
TOTAL	33	3445

Table 4.4: MADA-2006 : Types of Training Programs,
Number of Trainings and Number of Participants (Rice Farmers)

Training Courses for Rice Farmers	Number	Number of Participants
1. Motivation and Personal Development	3	145
2. Rice Yield Productivity Technology	8	596
3. Entrepreneurship and Skills Training	39	2926
4. Farmers Institute Development	9	461
5. Green Earth Campaign	4	800
6. Local Courses	96	4405
7. Farmers Day Visits	2	306
TOTAL	161	9693

From the above information, it was clear that more rice farmer trainings (161) as compared to agriculture extension officers' trainings (109), were conducted to upgrade the knowledge level of the farmers so as to enhance the dissemination of IPM technology and innovation to them.

Overall, it was indicated that the agricultural extension officers' role as intermediaries was strengthened due to the extensive amount of activities undertaken to enhance their knowledge of good plant protection practices and to disseminate that information to the rice farmers.

KADA : From the depth interview it was noted that the agricultural extension officers were not very enthusiastic in searching and understanding new IPM innovation. The key reason being that the rice farmers in KADA were poorer that those at MADA and they did not enjoy large profits as compared to MADA rice farmers. Furthermore, the new technology would incur additional expenses. Most of the farmers were too old to learn new innovative methods of IPM. This signified a lack of support for the agricultural extension officers to utilise their roles as disseminators, effectively.

Despite these setbacks, the top management in KADA was committed to enhancing the efficacy of IPM innovation and technology dissemination. Most of the activities carried out by the agricultural extension officers, were done locality by locality. For example, they organised "Gotong-Royong" or communal activities with the objective of cleaning up the peripheral areas, such that a cleaner environment would deter the invasion and habitation of pests such as rodents. However, many of the farmers were not cooperative and did not support this, relying instead on handling the rodent attacks on a case by case basis with the poisonous generation 2 or generation 3 pesticides. Another activity organised by the agricultural extension officers was the installation

of the “Lamp Traps”, which acted as a deterrent to some pests. However, the farmers were reluctant to use these lamp traps as this meant that they had to incur additional expenses for the electricity charges. They wanted the government or KADA to bear all the costs of the lamp traps as well as the electricity charges. Hence only a small percentage of the farmers were enthusiastic and supported the activities of the agricultural extension officers or intermediaries.

From a further research into the KADA Annual Reports for the years 2006 till 2008, it was discovered that the agricultural extension officers organised a multitude of activities with the Farmers’ Association. All these activities were listed in a chronological order and they formed a rich knowledge base as well as it acted as a record for the agricultural extension officers and top management of KADA. Figure 4.24 below listed the dates and activities organised for the year 2006, with respect to expos held, exhibitions as well as Farmer’s Carnivals.

Figure 4.24 : KADA -2006 Activities for the Rice Farmers

(Expos, Exhibitions and Farmer Carnivals)

Activities for KADA farmers	**Date**
1. Carnival AGROTEK KADA 2006	**13 April**
2. Launching of Club	**15 April**
3. Meet Farmers Day	**23 April**
4. Meet Farmers Day	**Johore state**
5. Kelantan Farms 2006	**12 August**
6. Meet Farmers Day	**21 August**
7. MAHA 2006	**21 – 27 November**
8. Meet Farmers Day	**7 December**
9. First Farm entry Day	**11 December**

Figure 4.25 below listed the dates and activities organised for the year 2006, with respect to educational field trips and visits by different groups such as university students, members of Parliament and rice farmers from other surrounding rice growing regions who had come to the 'Ladang Merdeka' to pick up pointers on effective farming techniques and methodologies.

Figure 4.25 : KADA -2006 Activities for the Rice Farmers

(Educational trips and visits)

Activities for KADA farmers	**Date**
1. Undergraduates UiTM Shah Alam	**4 March**
2. Members of Parliament Kelantan	**11 March**
3. Participants of Agri. Engineering Program	**25 April**
4. Teachers and Students	**3 May**
5. Rice Farmers Perak	**4 May**
6. Rice Farmers Penang	**13 June**
7. Rice Farmers North Perai	**14 June**
8. Rice Farmers North Perai	**5 July**
9. Officers and Leaders, Perlis	**11 July**

Figures 4.26 and 4.27 below listed the dates and activities organised for the year 2006, with respect to all the key events that took place such as the presentation of aid to all the flood-inflicted rice farmers, visit from the Minister of Agriculture, briefings on the latest developments and issues, visit from the Member of Parliament, short courses on planning for the agricultural extension officers and farmers, Annual General meetings at the various rice growing areas, among others.

Figure 4.26 : KADA -2006 Activities for the Rice Farmers

(Major Events)

Activities for KADA farmers	**Date**
1. Social Gathering – farmers and KADA Head	**18 March**
2. Official gathering of Project Mini Estate	**18 March**
3. Agrotek Carnival KADA	**1-3 April**
4. Social Gathering – farmers and KADA Head	**1-2 April**
5. Citizen Day KADA	**7 April**
6. Meeting for Planning Preparation	**12-13 April**
7. Social Gathering – farmers and KADA Head	**15 April**
8. Launching of Green Earth Campaign	**16 April**
10. Meeting for Agriculture Ministry farmers and Industry	**23 April**
11. Monthly Gathering of KADA constituents	**4 May**
12. Sports Carnival	**9-12 May**
13. Seminar on 9th Malaysian Plan	**21 May**
14. Meeting for Agriculture Ministry farmers and Industry	**18 June**

Figure 4.27 : KADA -2006 Activities for the Rice Farmers

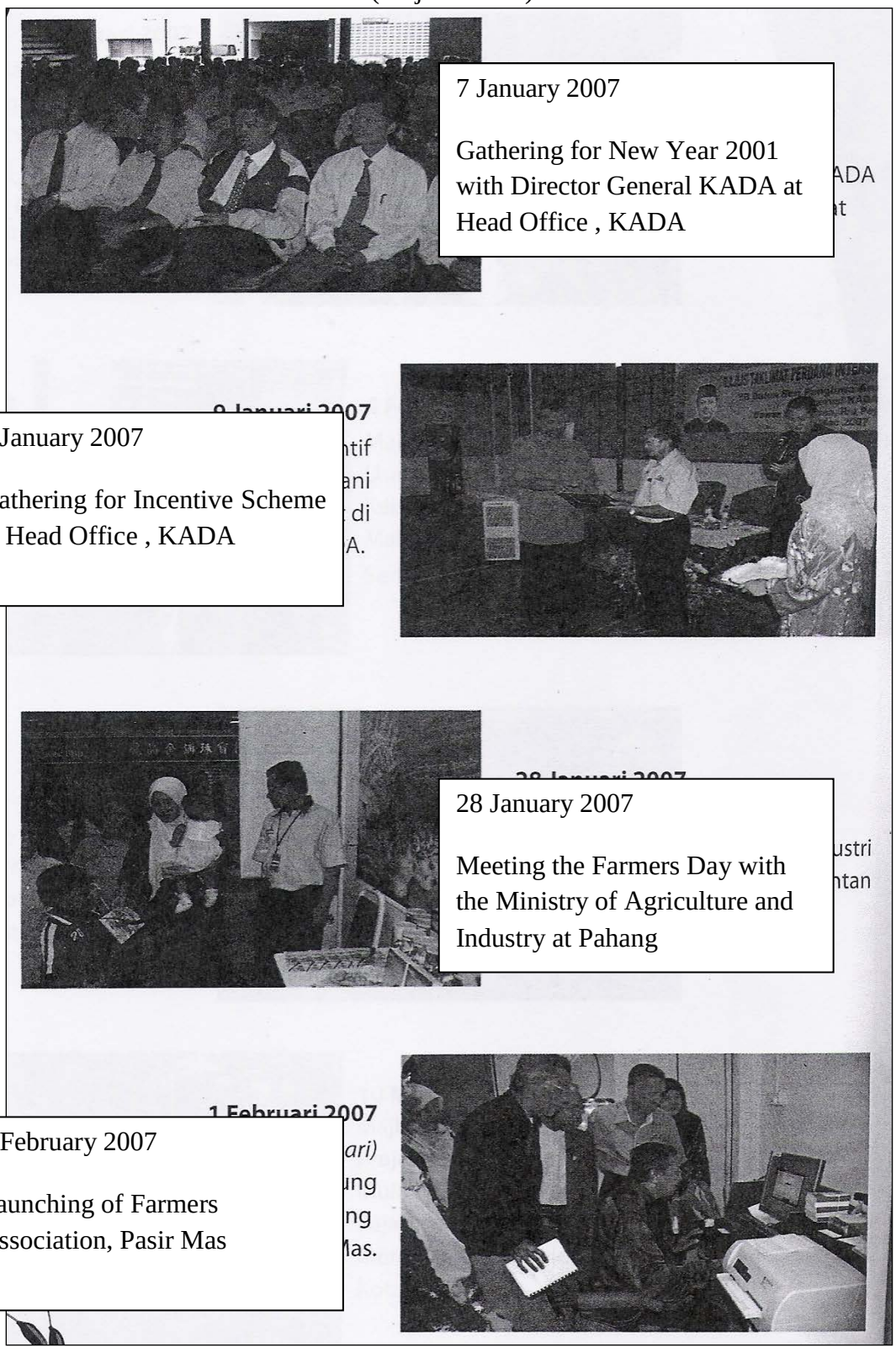
(Major Events – cont'd)

Activities for KADA farmers	**Date**
1. Official gathering for AGM - Jaya Peringat	**27 July**
2. Official gathering for AGM – Alor Mas	**30 July**
3. Official gathering for AGM – Nilam Puri	**30 July**
4. Social Gathering – farmers and KADA Head	**6 August**
5. Monthly Gathering of KADA constituents	**12 August**
6. Official Opening for Villages gathering	**18 August**
7. Official Closing for Villages gathering	**20 August**
8. Launching of KADA - Baloh Negara	**21 August**
9. Gathering for Distribution of Equipment Aid	**27 September**
10. Gathering for Distribution of Dividend	**27 September**
11. Monthly Gathering	**1 October**
12. Gathering for Farmers New Incentive	**6 October**

Similarly, for the years 2007 and 2008, the Annual Report provided a list of dates and corresponding events with pictures of the major events that transpired at the KADA granary. All these activities and events were organised by the management and the agricultural technical officers together with their respective tasks force. A snapshot of these was presented in Appendix II.

Figure 4.28 : KADA -2007 Activities for the Rice Farmers

(Major Events)



7 January 2007

Gathering for New Year 2001 with Director General KADA at Head Office , KADA

9 January 2007

Gathering for Incentive Scheme at Head Office , KADA

28 January 2007

Meeting the Farmers Day with the Ministry of Agriculture and Industry at Pahang

1 February 2007

Launching of Farmers Association, Pasir Mas

From the displayed snapshot pictures of events organised at the KADA rice granary for the years of 2007 and 2008 (Appendix II), it was evident that extensive effort was undertaken by the top management of that granary to instill good and proper practices of rice farming to the farmers. Although the intermediaries or agricultural extension officers continued to face an uphill task of changing the mindsets of the rice farmers who were old and were comfortable doing things the way they used to do, kudos had to be extended to them for making the effort to inculcate effective practices as propagated by IPM innovation and technology.

Additionally, from the pictures it was evident that a spirit of 'togetherness' was created by the top management team at KADA so as to provide additional confidence to the old farmers of their continuous support to the farmers. Actitivies such as ceremonies for the presentation of recognition awards such as 'Best Farmer' and 'Best Rice Field' were some of the continuous support provided to these rice farmers.

6. **Innovation Attributes** : Was there any significant change in the innovation attributes in both the granaries over the years 2001 till 2007 ?

MADA: In the recent years, the word 'commercialisation` had become a catch-phrase in all agriculture projects. While the technology was tested to be technically feasible, its implementation was evaluated to ensure that it was able to generate additional income to the farmers. Hence effort was expended to ensure that all technological packages were tailored to meet local needs. For example, IPM for rat control was implemented only in areas infested with rats.

Direct farmers participation was another successful technology adoption approach. The technology demonstration approach was conducted on the farmer's own land, with the farmers actually working on the demonstration plot. This proved to be a meaningful appreciation of the benefit of the technology, thus leading to successful adoption.

Additionally, in MADA, training of farmers had been based on their realistic needs and constraints, focusing on practical skills and relevant knowledge. For example, direct hands-on training was done in the implementation of rice field land levelling and water control boxes for the in-field water management technology. As a result, there now exists a core group of farmers who were capable of operating this IPM innovation.

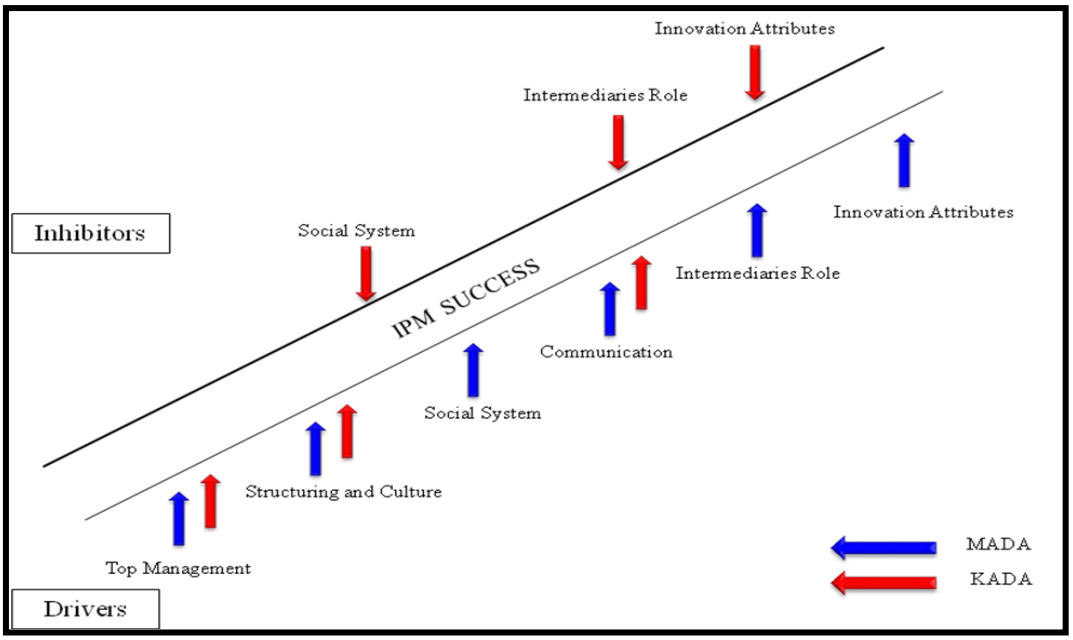
Overall it could be witnessed that the MADA rice farmers were more enthusiastic and hence more aggressive in their quest for knowledge on the new IPM innovation and technology. They were keen to learn the new technology faster so as to reap the maximum rewards from it.

KADA: From the interview conducted, it was revealed that very little support was given by the rice farmers to the agricultural extension officers in their efforts to make the IPM innovation into a reality. Only a small group of rice farmers were supportive. Hence only they reaped the maximum benefits from the innovation.

Overall, it could be said that there was not much improvement in terms of support for the IPM innovation being adopted successfully in KADA as the majority of the farmers were too comfortable in their prevalent mindsets.

From the re-visit, it was determined that all the six variables of the exploratory model were re-evaluated and the overall conclusions drawn could be depicted in Figure 4.29 below identifying which of the six variables were drivers and which were inhibitors to both the rice granaries of MADA and KADA.

Figure 4.29: IPM Success: Drivers and Inhibitors



From the pictorial description above, it could be concluded that the efficacy of IPM technology and innovation dissemination in KADA had improved significantly as many of the six key variables which were previously deemed 'inhibitors' in the 2001 interviews, had now become 'drivers' in the re-visit of 2007.

4.3.1 Part II: Demographic Details of the Respondents

The researcher conducted a case study and in depth interviews with a total number of 85 agricultural extension officers from MADA and 21 agricultural extension officers from KADA. This number represented 50% of the total agricultural extension officers from the respective granaries. This percentage was decided by the respective Heads of Department for each granary. A description of the demographic details that was captured in the questionnaire, was tabulated in the following table, Table 4.5.

Table 4.5: Summary of Demographic Details

Age (years)	**MADA**		**KADA**	
	n	**%**	**n**	**%**
Less than 30	2	2.3	2	9.1
Between 30 and 40	70	**82.4**	8	36.4
41 and above	13	15.3	11	**54.5**
Education				
Certificate from Institut Pertanian Malaysia	79	**92.9**	20	**95.5**
Bachelors Degree from Universiti Pertanian Malaysia	6	7.1	1	4.5
Years of Service				
Less than 5 – 10	33	38.8	2	9.5
11 – 20	34	**40.0**	10	**47.6**
More than 20	18	21.2	9	42.9
Total	**85**	**100**	**21**	**100**

With respect to age, it could be seen from the table above that the majority of the agricultural extension officers in the region of MADA was between the age of 30 and 40 years, whereas in the region of KADA, the average age of the majority of them was 41 and above.

With respect to the education level, it was discovered that a large majority of the respondents possessed an education level of 'Certificate' from the Institute of Agriculture, Malaysia. This was evident in both the granaries with MADA having a percentage of 93% whereas in KADA, the percentage was 96%.

With respect to the years of service, it was revealed that the majority of the agricultural extension officers from both locations had between 11 to 20 years of experience, with MADA having 40% and KADA having 48%. This was followed by 21 % in MADA and 43% in KADA having more than 20 years of service in rice cultivation.

Overall, we could see from the demographic details that the majority of the agricultural extension officers from the two largest rice granaries in Malaysia were more than 30 years of age, possessed at least a certificate in agricultural studies and had at least about 11 years of experience in rice cultivation.

4.3.2 Part III : Influencing Variables : Knowledge

The Part III of the questionnaire was dedicated to the Influencing Variables of this research study. In Part III, an investigation was conducted that focussed on the 'IPM Knowledge' level of the agricultural extension officers. This was measured by the open-ended question of 'Whether

they could identify the characteristics of an IPM farmer as well as distinguish the characteristics of a Non-IPM farmer'. The open-ended question format was proposed by the international panel of experts from IRRI as they felt that the true depth of knowledge of the agricultural extension officers could be better measured this way. They sensed that by presenting a set of close-ended alternatives to the respondents, the researcher may not be able to extract an accurate reflection of the level of understanding and knowledge of good IPM practices from the respondents.

However, the major limitation of this format was that the relationships between the variables could not be studied in depth This format did not facilitate the ability to check the correlation between these knowledge scores with the attitude and practice scores as secured from Section 2 and Section 3 of the questionnaire. The key reason being the knowledge questions were open-ended while the attitude and practice questions were 'dual-response'.

Although this proved to be a limitation, however, many other similar research were conducted using this methodology as it helped to surface the 'big picture' of the real situation faced by the respondents. An outstanding example was the work commissioned by Dex et al., (2000) who presented a study on flexible working of TV production workers in Britain 1994-1997. In this study, they integrated a mixture of data as they analysed the information from the questionnaire and matched it with the qualitative commentaries made by the respondents as there was open space for comments to be made by the respondents. This gave a triangulated flavour to the data collection method, which eventually indicated clearly that a multi-perspective triangulation illuminated aspects of work that had been hidden in the standard survey-based studies.

Fagan et al., (2003) and Warren (2000), illustrated in their work that the resulting research methodology could easily integrate different types of research data as they used a range of types of data, including qualitative data, policy documents and also secondary data.

Galle (1998) also concurred that qualitative research threw light on aspects of the workers' relationships with the employer and other potential employers, whereas the standard close-ended employment research could easily misconstrue important dimensions as being irrelevant.

Most research on consumption illustrated that the triangulation debate had an economistic and individualistic simplified strand when it studied expenditure data (Sefton and Veld, 1999). For example, the research on consumption undertaken by Warde and Martens (2000), gave a full qualitative discussion of the class effect using a wide array of secondary data. This effort was complemented with quantitative analysis of primary survey data. Since such studies routinely used triangulation and find survey data invaluable for unpicking complex interacting causal mechanism, several of the empirical researchers on consumption have shown an explicit awareness of epistemological issues.

Two classic studies of USA, France and other countries used a mixture of tabulated information and qualitative data (Folbre, 1994). They conducted a comparative study of how families negotiated self-employment and farming work. This study proved to be path-breaking. In Folbre's study about public policy, it used a comparative method as well as detailed case study material and showed that women were constrained by policy and social norms, from engaging in labour markets and they tend to internalise their own socially-imposed limitations, as compared to men.

Economists on the other hand, have rejected social statistics for the reason that its apparent objectivity and its impersonal nature made it too authoritative and was subjected to the danger of over simplification and untested universalism (Truman et. al., 1999). However, this viewpoint ignored the possibility that the interpretation of social statistics could have a more thoughtful, critical and reflexive standpoint, by combining it with rich qualitative information. This could help bridge the gap and reach a more acceptable version of objectivity rather than the idea that statistics were just mere facts that spoke for themselves (Harding, 2001).

The work of the agricultural extension officers advocated an integrated and holistic approach in extension work such as; strategy development, programme planning and management, multi-media materials design and development, field implementation, training, media, monitoring and evaluation. To secure these sources of information, the agricultural extension officers employed a behavioural science methodology that was based on a participatory needs assessment and an identification of the problems of the rice farmers. This would facilitate the development of appropriate strategies and tactics to overcome or minimize human-related constraints that affected the agricultural technology transfer and application process.

Additionally, it was discovered that the non-adoption of recommended IPM technology or innovation was often related to or caused by non-technological factors, such as socio-psychological, socio-cultural and socio-economic problems. These were the human key factors that helped to facilitate IPM adoption of new technology and innovation and also helped to motivate the continued practice of the recommended IPM technology by the rice farmers. Hence, attention needed to be paid to the human key variables as well as its environmental

factors, as both these key variables were a critical influence on the decision making process related to agricultural technology adoption and practices. Without sufficient understanding of the human side of the farmers, their attitudes and behaviour towards a given technology, the "technology transfer" process would be slowed down and eventually become ineffective.

As it became evident that much of the extension work needed to give adequate consideration to human behavioural aspects rather than heavy "technology-bias", this research study attempted to capture that essence through utilising exploratory methodologies. This was done by capturing qualitative information through the open-ended questions of the six key variables; the qualitative information of the influencing variables of the KAP as well as the secondary data of the performance indicators. An attempt was then made to draw conclusions to form a coherent summary of the findings and show the connections between the effect on the performance indicators as brought about by the strength of the influencing variable as well as the strength of the six key variables.

- **Knowledge Variable – Characteristics of an IPM Farmer**

In this study, the agricultural extension officers enumerated a total of 25 characteristics of IPM farmers. All these statements were assigned a weight by the international panel of experts, who designed the scoring system. A weight of ‘5’ was given to a statement or characteristic which indicated a high level of accuracy of the description of an IPM farmer, while a weight of ‘1’ was given to a statement that depicted the weakest description.

A summarised analysis of the respondents' statements displayed that out of the 25 responses secured from the agricultural extension officers, there were fourteen statements that were ranked as the most accurate description of an IPM Farmer, earning the weight of '5', while four characteristics were given the weight of '4', two descriptions were given the weight of '3', three features were given the weight of '2' and two qualities were given the weight of '1'. A summary of the above was presented in Table 4.6 below.

Table 4.6 : Knowledge: IPM Farmer Characteristics' and Weightings

No.		Weighting
A1	They know when to use, how much to use, and how to use the pesticides	5
A2	Will use pesticides that have low toxic effect on natural enemies and fish and Has less outbreaks of rice diseases	5
A3	Since costs of pesticides Class III and IV are expensive, they rather not use to keep costs low	5
A4	Level of damage by pests is low because less usage of pesticides	5
A5	Does not use broad spectrum class of pesticides	5
A6	Knowledgeable to take appropriate action, ie. Decision making is good	5
A7	Participates in campaign, courses, other activities	5
A8	Have seen and can recognise natural enemies	5
A9	Can recognise rice diseases and weeds	5
A10	Uses good quality seeds	5
A11	More time invested on rice fields	5
A12	Rice plants look healthy	5
A13	Checks fields daily	5
A14	They have continuous control of weeds. They know the timing of when exactly to use the herbicides	5
B1	Rice fields well kept and has inspection lanes	4
B2	Rice fields are neat and tidy and land well prepared	4
B3	Go often into their inspection lanes	4
B4	Have pest control knowledge	4
C1	Open-minded, willing to receive new information	3
C2	Invests high capital and treats this as a business to make profits	3
D1	All action follow the guidelines of the extension officers	2
D2	Will contact extension officer if don't understand or need advice	2
D3	Willing to try new ideas and new technology	2
E1	Usually holds some posts eg. Head of Units, Village Head, etc	1
E2	Land preparation done with other farmers in group farming	1

Once the individual scores were assigned to the characteristics or statements made by the respondents, the total scores and the respective percentages were computed. The results were as shown in the Table 4.7 below.

Table 4.7: Total Scores and Percentages for MADA and KADA

No.		Weighting	MADA		KADA	
			N	%	N	%
A1	They know when to use, how much to use, and how to use the pesticides	5	36	2.12	7	1.67
A2	Will use pesticides that have low toxic effect on natural enemies and fish and Has less outbreaks of rice diseases	5	30	1.76	6	1.43
A3	Since costs of pesticides Class III and IV are expensive, they rather not use to keep costs low	5	36	2.12	6	1.43
A4	Level of damage by pests is low because less usage of pesticides	5	31	1.82	5	1.19
A5	Does not use broad spectrum class of pesticides	5	25	1.47	3	0.71
A6	Knowledgeable to take appropriate action, ie. Decision making is good	5	32	1.88	3	0.71
A7	Participates in campaign, courses, other activities	5	30	1.76	2	0.48
A8	Have seen and can recognise natural enemies	5	28	1.65	3	0.71
A9	Can recognise rice diseases and weeds	5	28	1.65	8	1.90
A10	Uses good quality seeds	5	26	1.53	5	1.19
A11	More time invested on rice fields	5	33	1.94	0	0.00
A12	Rice plants look healthy	5	32	1.88	7	1.67
A13	Checks fields daily	5	24	1.41	6	1.43
A14	They have continuous control of weeds. They know the timing of when exactly to use the herbicides	5	24	1.41	4	0.95
B1	Rice fields well kept and has inspection lanes	4	35	1.65	7	1.33
B2	Rice fields are neat and tidy and land well prepared	4	34	1.60	4	0.76
B3	Go often into their inspection lanes	4	36	1.69	0	0.00
B4	Have pest control knowledge	4	35	1.65	8	1.52
C1	Open-minded, willing to receive new information	3	35	1.24	6	0.86
C2	Invests high capital and treats this as a business to make profits	3	30	1.06	0	0.00
D1	All action follow the guidelines of the extension officers	2	34	0.80	7	0.67
D2	Will contact extension officer if don't understand or need advice	2	30	0.71	0	0.00
D3	Willing to try new ideas and new technology	2	39	0.68	0	0.00
E1	Usually holds some posts eg. Head of Units, Village Head, etc	1	33	0.39	1	0.05
E2	Land preparation done with other farmers in group farming	1	28	0.33	1	0.05

From Table 4.7, it could be seen that there were 14 statements that were awarded the strongest weight of '5' as they represented the most accurate description of the characteristics of the IPM farmer. This weightage was provided by the panel of experts. For the second highest weight of '4', there were only 4 statements that accurately described the characteristics of the IPM farmer. This was followed by nearly an equal number of statements for the weightage of '3' and '2' and '1'.

Overall it can be deduced that the agricultural extension officers' level of knowledge of the characteristics of IPM farmer was relatively high as they managed to secure the largest number of '5' weightage for the IPM farmer characteristics that they had generated in the case study and in depth interviews held with them.

A cross comparison analysis was conducted to see if there was any difference between MADA and KADA's weightage of '5' to the characteristics generated by the agricultural extension officers. This was done by calculating the percentages for the responses of MADA and KADA. Then the average scores were calculated. The results were as shown in Table 4.8 below.

Table 4.8: Average Scores for MADA and KADA

	MADA	**KADA**
AVERAGE	1.45	0.83

By examining the average scores of all the characteristics of an IPM farmer, it was indicative that the MADA agricultural extension officers were more knowledgeable regarding IPM farmer characteristics as compared to the KADA agricultural extension officers, as their average scores were higher. The key reason leading to this could be the presence of the six key variables in MADA which acted as drivers for creating a supportive environment where IPM technology and innovation would be more successfully implemented as compared to KADA, which had only one driver.

- **Knowledge Variable – Characteristics of a Non- IPM Farmer**

In Part III of the questionnaire under Section 1: tests on the knowledge of the agricultural extension officers with respect to the characteristics of a Non-IPM farmer.

A total of 17 statements of Non-IPM farmers were recorded. All these statements were assigned a weight by the international panel of experts, similar to that for the IPM farmer characteristics. A summarised analysis of the respondents' statements displayed that out of the 17 responses secured, there were five that were ranked as the most accurate description of a Non-IPM Farmer, earning the weight of '5', while five characteristics were given the weight of '4', four descriptions were given the weight of '3', two features were given the weight of '2' and one quality was given the weight of '1'. A summary of the above was presented in Table 4.9 below.

Table 4.9 : Knowledge: Non-IPM Farmer Characteristics' and Weightings

No.		Weighting
A1	Farmers, who want quick action on pests, therefore use highly toxic pesticides (broad spectrum) because all pests can be seen to die instantly eg. If fish in the fields die, then the pests in the fields will also be dead	5
A2	They can buy pesticides easily from Thailand, especially since Class I and II are much cheaper and more effective	5
A3	Will spray if little damage because afraid of incurring loss	5
A4	Not convinced that specific spectrum pesticides will do the job, ie. They are worried that the pests will still be alive after the spray	5
A5	Wants to have power to make own decisions based on own experience "sikap persendirian"	5
B1	Difficult to accept new technology	4
B2	Too tedious IPM methods eg. Surveillance, close monitoring of rice fields… too impractical for the old farmers	4
B3	They can get credit from the pesticides shops which are located near their farms as compared to the Farmers Association which is located very far	4
B4	They want high yield and are not bothered about the effects on humans/environment/natural enemies	4
B5	Must see neighbours evidence of success of new technology	4
C1	Not interested in meeting the extension officers	3
C2	Part-time farmers who don't have enough income to pay workers to tend to fields	3
C3	Usually owns small plots of field, therefore don't receive enough income	3
C4	They are part-time farmers who work as government servants and who do not have enough time to look into the daily affairs of the field	3
D1	They don't want to follow the new technology ie. They spray before the ETL	2
D2	Old farmers- "kita makan garam dulu" they follow their own perception, observations because of their experience	2
E1	They are lazy and too old. Therefore they want easy procedures	1

Once the individual scores were assigned to the characteristics or statements made by the respondents, the total scores and the respective percentages were computed. The results were as shown in the Table 4.10 below.

Table 4.10: Total Scores and Percentages for MADA and KADA

No.		Weighting	MADA		KADA	
			N	%	N	%
A1	Farmers, who want quick action on pests, therefore use highly toxic pesticides (broad spectrum) because all pests can be seen to die instantly eg. If fish in the fields die, then the pests in the fields will also be dead	5	29	1.71	5	1.19
A2	They can buy pesticides easily from Thailand, especially since Class I and II are much cheaper and more effective	5	32	1.88	6	1.43
A3	Will spray if little damage because afraid of incurring loss	5	28	1.65	5	1.19
A4	Not convinced that specific spectrum pesticides will do the job, ie. They are worried that the pests will still be alive after the spray	5	30	1.76	5	1.19
A5	Wants to have power to make own decisions based on own experience "sikap persendirian"	5	24	1.41	2	0.48
B1	Difficult to accept new technology	4	29	1.36	0	0.00
B2	Too tedious IPM methods eg. Surveillance, close monitoring of rice fields… too impractical for the old farmers	4	29	1.36	2	0.38
B3	They can get credit from the pesticides shops which are located near their farms as compared to the Farmers Association which is located very far	4	30	1.41	2	0.38
B4	They want high yield and are not bothered about the effects on humans/environment/natural enemies	4	30	1.41	2	0.38
B5	Must see neighbours evidence of success of new technology	4	31	1.46	0	0.00
C1	Not interested in meeting the extension officers	3	33	1.16	0	0.00
C2	Part-time farmers who don't have enough income to pay workers to tend to fields	3	34	1.20	6	0.86
C3	Usually owns small plots of field, therefore don't receive enough income	3	34	1.20	5	0.71
C4	They are part-time farmers who work as government servants and who do not have enough time to look into the daily affairs of the field	3	34	1.20	0	0.00
D1	They don't want to follow the new technology ie. They spray before the ETL	2	35	0.82	5	0.48
D2	Old farmers- "kita makan garam dulu" they follow their own perception, observations because of their experience	2	31	0.73	6	0.57
E1	They are lazy and too old. Therefore they want easy procedures	1	35	0.41	8	0.38

From Table 4.10, it could be seen that there were 10 out of 17 statements that were awarded the strongest weights of '5' and '4', as they represented the most accurate description of the characteristics of a non-IPM farmer. This weightage was provided by the panel of experts. There were only 4 statements that had a weight of '3'.

Overall it can be deduced that the agricultural extension officers' level of knowledge of the characteristics of non-IPM farmer was relatively high as they managed to secure the largest number of '5' and '4'weightage for the non-IPM farmer characteristics that they had shared in the case study and in depth interviews held with them.

A cross comparison analysis was conducted to see if there was any difference between MADA and KADA's weightage of '5' and '4' to the characteristics generated by the agricultural extension officers. This was done by calculating the percentages for the responses of MADA and KADA. Then the average scores were calculated. The results were as shown in Table 4.11 below.

Table 4.11: Average Scores for MADA and KADA

	MADA	**KADA**
AVERAGE	1.30	0.57

By examining the average scores of all the characteristics of a non-IPM farmer, it was indicative that the MADA agricultural extension officers were more knowledgeable regarding non-IPM farmer characteristics as compared to the KADA agricultural extension officers, as their average scores were higher. The key reason leading to this could be the presence of the six key variables in MADA which acted as drivers for creating a supportive environment where IPM technology

and innovation would be more successfully implemented as compared to KADA, which had only one driver.

4.3.3. Part III : Influencing Variables : Attitude

In Part III of the questionnaire under Section 2: an investigation was conducted to determine the Attitude of the agricultural extension officers with respect to IPM innovation and practices. 10 'dual-response' questions were composed by the international panel of experts specifically to measure the influencing variable of Attitude. 10 constructs represented the Attitude questions. The Attitude variables were measured by asking the respondents to state their level of agreement to the list of 10 constructs. They denoted their preference by choosing from the dual-response of 'Yes' or 'No'.

The responses from all the respondents (85 from MADA and 21 from KADA) were analysed. The tabulated results from the analysis were depicted in Table 4.12 below.

Table 4.12 : Average Scores for 10 Attitude constructs

Item		Average
A1	Farmers should be able to recognise all rice insect pests	5.91
A2	Farmers should be able to recognise all rice diseases	5.90
A3	Farmers should be able to recognise all weeds affecting rice	5.98
A4	Farmers should be able to recognise the beneficial insects in rice fields	5.92
A5	Farmers should appreciate the natural enemies and strive to protect them	5.92
A6	Farmers should not mind when their crops are slightly damaged by insects	5.72
A7	Farmers should not overestimate losses due to damage by pests	5.14
A8	Farmers should know that pesticides are bad for health	5.99
A9	Farmers generally have little knowledge of pest control	1.59
A10	Farmers should recognise pests from eggs to adult	3.00

In Table 4.12 above, it could be seen that 8 out of 10 statements depicting the desired 'attitude' behaviour pattern were rated with high average scores by the respondents. These high average scores represent a very high level of understanding of the desired 'attitude' that the agricultural extension officers should have toward implementing prudent IPM technology and innovation.

Overall it can be deduced that the agricultural extension officers' 'attitude' towards their duties in being the change agent and early adopters seem to be at a desirable level.

4.3.3. Part III : Influencing Variables : Practice

In Part III of the questionnaire, under Section 3: an investigation was conducted to determine the Practice of the agricultural extension officers with respect to IPM innovation and practices. 10 'dual-response' questions were composed by the international panel of experts specifically to measure the influencing variable of Practice. 10 constructs represented the Practice questions. The Practice variables were measured by asking the respondents to state their level of agreement to a list of constructs. They denoted their preference by choosing from the dual-response of 'Yes' or 'No'.

The responses from all the respondents (85 from MADA and 21 from KADA) were analysed. The tabulated results from the analysis were depicted in Table 4.13 below.

Table 4.13 : Average Scores for 10 Practice constructs

Item		Average
B1	Farmers continue to use pesticides because they feel they are strong enough to use them	4.84
B2	Farmers should use insecticides all the time to have high yields	5.75
B3	Farmers should use herbicides or their crops will have low yields	5.29
B4	Farmers should spray their crops according to a calendar schedule	5.68
B5	Farmers should spray insecticides when they see insects in their fields	2.93
B6	Farmers should spray pesticides using a threshold criteria	2.96
B7	Farmers should spray pesticides to ensure no loss	2.87
B8	Extension technicians generally give the best pest control advice to farmers	5.88
B9	Extension technicians should be adequately trained to give advice to farmers	5.95
B10	Extension advice given are generally followed by the farmers	2.92

In Table 4.13 above, it could be seen that only 5 out of the 10 constructs depicting the desired 'practice' behaviour pattern were rated with high average scores by the respondents. These scores are disappointing as compared to their scores for the 10 'attitude' constructs. These results represent a very mediocre level of understanding of the desired 'practice' that the agricultural extension officers should have toward implementing prudent IPM technology and innovation.

Overall it can be deduced that the agricultural extension officers' appreciation of their role and 'practice' towards their duties in being the change agent and early adopters to the rice farmers, do not seem to be at a desirable level, rather only at a mediocre level. Hence, we can conclude that currently there isn't a high level of efficacy in implementing the IPM technology and innovation as the 'practice' scores were mediocre. If a high level of efficacy was desired by MADA and KADA, then more effort should be expended by these two rice granaries. Budgets should be allocated for more training to sharpen the 'practice' skills of the agricultural extension officers, such that they become effective agricultural extension officers.

4.4 IPM Performance Indicators

1. Yield per Granary Area

With reference to the Figure 4.15 below, it was determined that there were many contributing key variables that affected the yield levels in rice granaries. Some of them included; seed quality, water status, plant nutrient, soil, fertiliser management, pests, diseases, etc. Hence we could infer that by managing the pest levels through a systematic process of IPM, the yield levels could be

greatly enhanced. An attempt was made to identify the yield levels in both the rice granaries over a period of time to see if there were any significant changes.

Figure 4.30 : Key variables that Affect Rice Yields

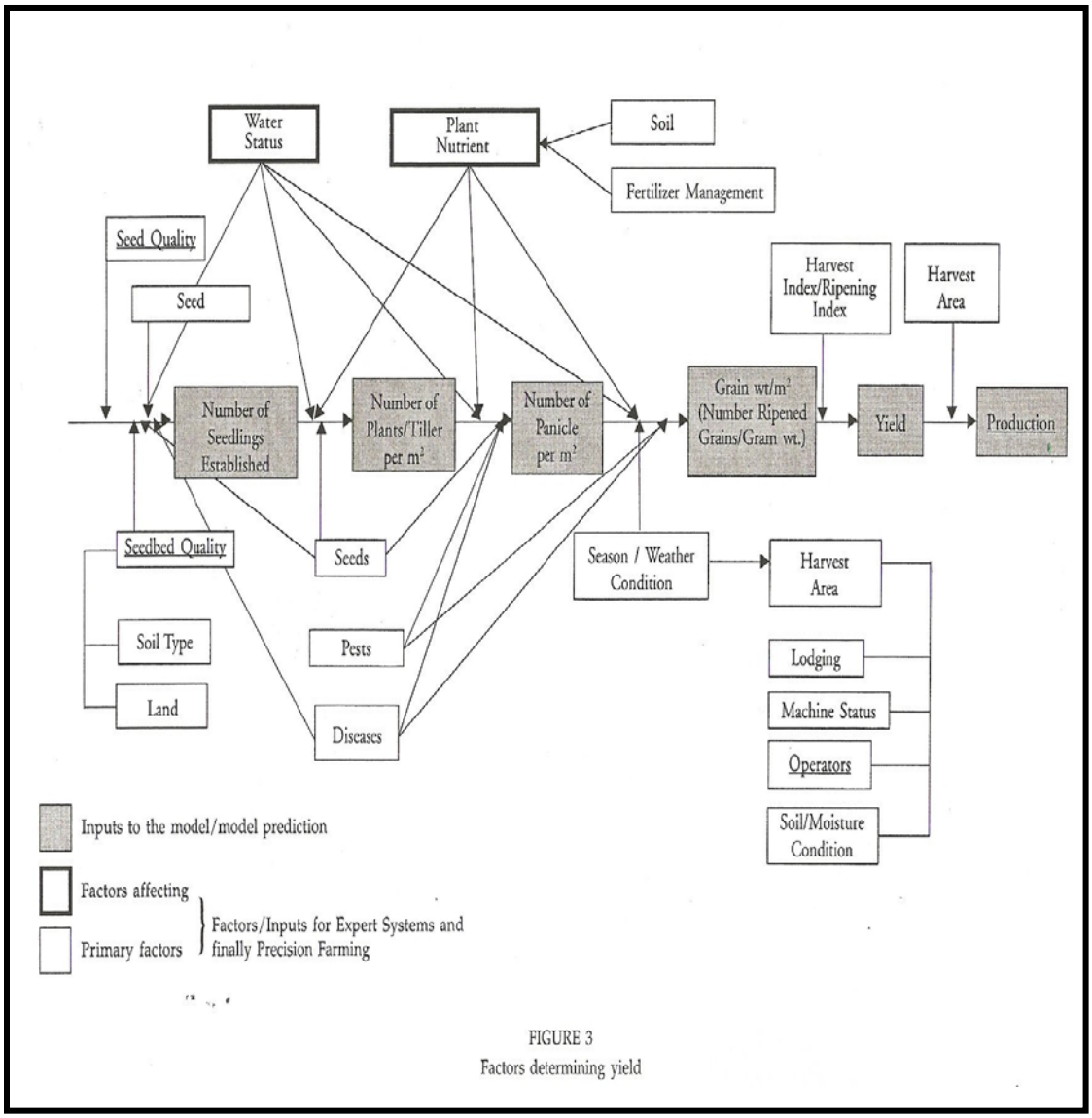
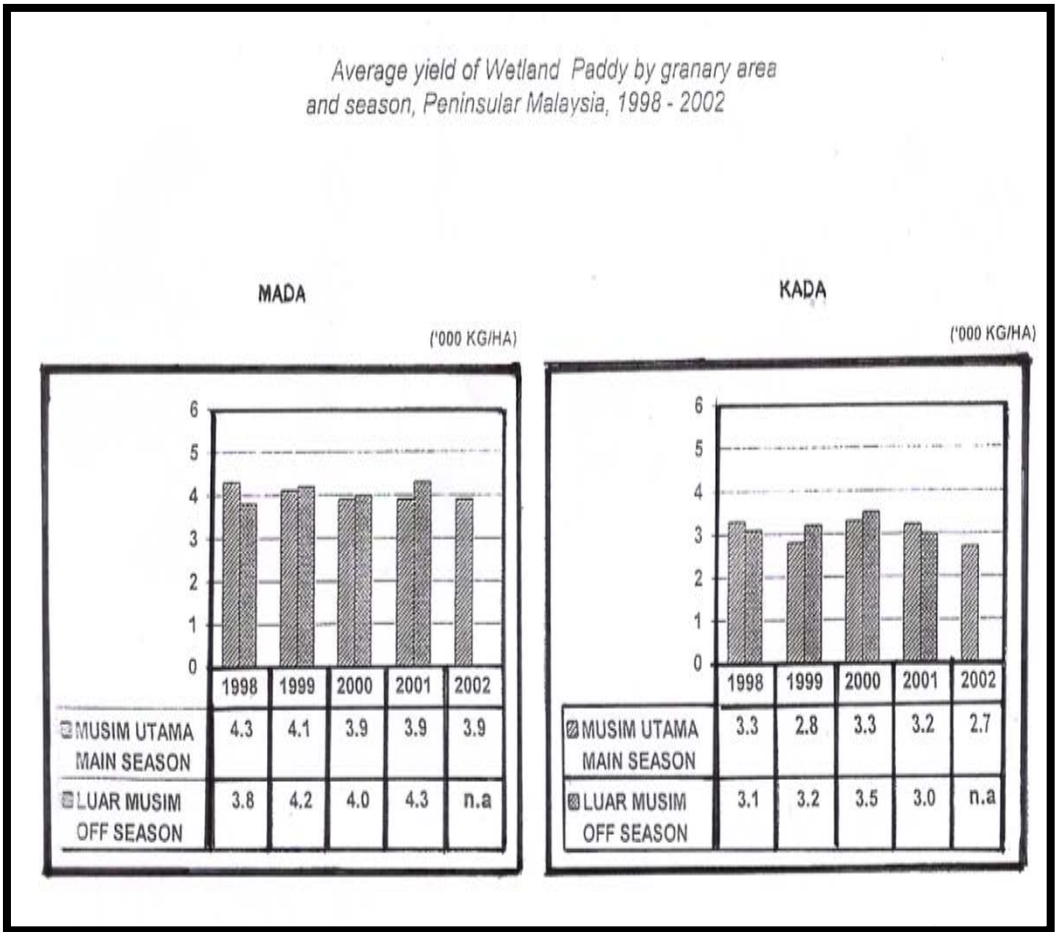


Table 4.14 : Yield per Granary Area



The two graphs above showed the average yield of rice over the years of 1998 till 2002 for the two largest rice granaries in Malaysia. It could be seen that the MADA granary had a higher level of yield for the period of 1998 till 2002, as compared to that for KADA, for both the main season and also for the off season crop.

From another source, the following table was elicited. From Table 4.15 below it was determined that over the years of 1987 till 1995, the output in MADA was much higher than that of KADA.

Table 4.15 : Production of Rice in Granary Areas (1000 t)

Granary area	Year								
	1987	1988	1989	1990	1991	1992	1993	1994	1995
MADA	576.8	651.3	672.4	724.9	752.8	763.9	788.0	846.2	862.2
KADA	93.1	117.9	117.0	163.7	178.9	201.3	199.5	188.2	181.2

Additionally, the researcher was able to secure some yield information from KADA with respect to the Merdeka Farm. This was displayed in Tables 4.16 and 4.17 below.

Table 4.16 : Main Season of Merdeka Farm KADA

Year	Total farm	Farm area/ha	Operation Area/ha	Total Participant	Average Productivity tan/ha	Project Cost (RM)	Average Profit/ha (RM)
1996	6	243.48	209.13	990	**3.26**	6,274.23	947.07
1997	8	306.6	268.02	1,205	**3.34**	9,730.07	1,016.43
1998	9	349.78	306.88	1,340	**3.37**	-	1,334.29
1999	8	319.47	277.52	1,340	**4.07**	-	1,852.85
2000	10	454.55	398.68	1,706	**3.34**	-	1,134.03
2001	10	454.55	398.68	1,706	**2.39**	-	342.91

Table 4.17 : Off Season of Merdeka Farm KADA

Year	Total Farm	Farm Area/ha	Operation Area/ha	Total Participant	Average Productivity /tan/ha	Project Cost (RM)	Average Income/ha (RM)
1996	6	276.29	238.66	1,115	**3.10**	26,473.53	1,134.80
1997	8	319.47	277.52	1,340	**3.55**	18,856.58	1,695.12
1998	9	319.47	277.52	1,340	**2.90**	-	1,015.44
1999	8	319.47	277.52	1,340	**3.06**	-	1,260.84
2000	10	424.24	369.32	1,706	**3.35**	-	1,342.23
2001	10	424.24	369.32	1,706	**2.90**	-	924.43

From the above tables 4.16 and 4.17 it could be seen that the yield per ha for both the main season and off season was relatively high (as shown in bold). This was the special rice farming areas which were segmented for modern farm management called the Merdeka Farm.

Similarly, for the MADA rice granary, yield information was secured for the years of 2000 and 2001. The information was displayed in Table 4.18 below. We can see that the yield (as shown in bold) was comparative to the yield from the Merdeka Farm in the KADA rice granary.

Table 4.18 : Yield for MADA

Year	Total Planting area	Total Yield / ha	Total Productivity
2000	51,086	**3.96**	202,872
2001	48,767	**3.78**	184,369

Overall, it could be seen that a higher level of yield was enjoyed by the MADA rice granary as compared to the KADA rice granary, for both the main seasons and the off seasons. The only exception was the yield from the Merdeka Farm in the KADA rice growing region. This farm's yield was comparative to the MADA rice yields. This was because this farm was managed by a professional farm management team whose main objective was focussed on yield improvement.

2. Major Pest Outbreak Levels

An effort was made to secure information with respect to the level of pest outbreaks in both the rice granary areas of MADA and KADA. It could be inferred that if the number of major pest outbreaks was decreasing then it could be concluded that better IPM practices were being adopted. However, information could only be secured from the MADA granary as there were no records in KADA. The Table 4.19 below indicated the different types of pest outbreaks over the period of 1979 till 1984. It could also be observed that there was no consistent pattern of reduction or increment in the number of pest attacks, but rather a haphazard pattern. Hence no conclusions could be drawn on whether the IPM practices were adopted or implemented more successfully in MADA. The reasons for the fluctuation could be varied, and this warranted a more in depth study as to the causes.

Table 4.19 : Major Pest Outbreak in MADA

STATUS OF MAJOR PEST OUTBREAK IN THE MUDA AREA (HECTARES) (1979-1984)

Crop Year	PMV	BPH/WBPH	RODENTS	SCOTINOPHORA COARCTATA
1979	–	21,492	156	–
1980	–	668	547	–
1981	5,884	615	2,633	–
1982	5,839	7,761	100	–
1983	8,655	11,874	1,116	553
1984	499	1,006	6,794	2,366

3. Herbicides Usage Levels

An effort was made to secure information with respect to the level of herbicides usage in both the rice granary areas of MADA and KADA. It could be inferred that if the volume of herbicides usage was decreasing then it could be concluded that better IPM practices were being adopted as there were less rice plant diseases. However, information could only be secured from the MADA granary as there was no information collected on herbicides level in KADA. The Table 4.20 below indicated the different types of herbicides used over the period of 1980 till 1995. It could also be observed that there was no consistent pattern of reduction or increment in the volume of herbicides usage as some of them were decreasing over the years, while others were increasing, rendering a rather haphazard pattern. Hence no conclusions could be drawn on whether the IPM practices were adopted or implemented more successfully in MADA. The reasons for the fluctuation could be varied, and this warranted a more in depth study as to the key reasons behind these fluctuations.

Table 4.20 : Estimated Usage of Herbicides in MADA (in metric tons)

Types of herbicide	Year												
	1980	1983	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2,4-D IBE	100	180	250	280	250	250	200	160	150	150	150	140	145
2,4-D Sodium Salt	50	20	NA	NA	NA	30	10	8	5	4	4	4	4
2,4-D Amine	5	20	150	150	140	130	60	50	40	30	30	30	30
MCPA	1	NA	1	1	1	-	-	-	-	-	-	-	-
Molinate	-	10	110	195	265	380	600	500	550	250	240	70	50
Molinate & Propanil	-	-	-	-	-	8	10	10	10	5	6	5	5
Oxadiazon	-	-	10	10	6	6	6	2	2	-	-	-	-
Propanil	-	-	-	2	14	20	22	26	25	20	25	20	15
Thiobencarb	-	-	-	-	-	50	50	10	-	-	-	10	5
Thiobencarb + Propanil	-	-	-	-	-	-	-	-	-	6	8	30	45
EPTC	-	-	-	-	-	-	20	19	20	50	58	40	40
Pretilachlor	-	-	-	-	-	-	5	6	5	5	7	8	8
Paraquat	10	80	300	320	320	320	330	300	270	250	225	250	240
Glyphosate	-	-	-	-	-	-	-	-	-	20	25	30	40
Fenoxaprop	-	-	-	-	-	-	-	-	7	5	8	6	6
Sethoxydim	-	-	-	-	-	-	-	-	-	8	3	2	-
Quinchlorac	-	-	-	-	-	-	-	-	-	2	2	1	1
Others	NA	NA	1	2	3	6	5	6	8	9	9	10	12
Total	166	310	822	960	999	1200	1318	1097	1092	814	800	656	646

4. Insecticides Usage Levels

An effort was made to secure information with respect to the level of insecticides usage in both the rice granary areas of MADA and KADA. It could be inferred that if the quantity of insecticides usage was decreasing then it could be concluded that better IPM practices were being adopted. However, information could only be secured from the MADA granary as there was no information collected on insecticides level in KADA. The Table 4.21 below indicated the different types of insecticides used over the period of 1980 till 1996. It could also be observed

that there was a consistent pattern of reduction in the quantity of insecticides usage over the years. Hence it could be concluded that the IPM practices were adopted and implemented successfully in MADA over the period of 1980 till 1996.

Table 4.21 : Estimated Usage of Insecticides in MADA (in metric tons)

Types of insecticide	Year						
	1980	1986	1990	1992	1994	1995	1996
Gamma BHC (granulated formulation)	200	80	-	-	-	-	-
Endosulfan (granulated formulation)	280	60	15	5	4	-	-
Endosulfan (EC formulation)	10	20	40	40	20	10	5
MTMC + phenthoate	120	25	20	12	2	20	11
Cartap	-	-	-	-	-	4	7
Imida cloprid	-	-	-	-	-	0.5	1
Carbofuran	100	200	350	150	120	150	89
Propoxur	10	2	-	-	-	-	-
BPMC	10	20	20	3	3	5	3
MIPC	-	5	3	1	1	5	2
Monocrotophos	NA	2	20	-	-	-	-
Methamodophos	NA	1	10	-	-	-	-
IGR	-	-	-	2.5	2.8	2	2
Synthetic pyrethroid	-	-	-	-	-	9	9
Others	3	5	8	5	5	3	8

5. Rodenticides Usage Levels

An effort was made to secure information with respect to the level of rodenticides usage in both the rice granary areas of MADA and KADA. It could be inferred that if the quantity of rodenticides usage was decreasing then it could be concluded that better IPM practices were being adopted. However, information could only be secured from the MADA granary as there was no information collected on rodenticides level in KADA. The Table 4.22 below indicated the different types of rodenticides used over the some years covering the period of 1981 till 1996. It could also be observed that there was a consistent pattern of reduction in the quantity of rodenticides usage in the years indicated. Hence it could be concluded that the IPM practices

were adopted and implemented successfully in MADA in the years indicated which covered the period of 1981 till 1996.

Table 4.22 : Distribution of Rodenticides in MADA

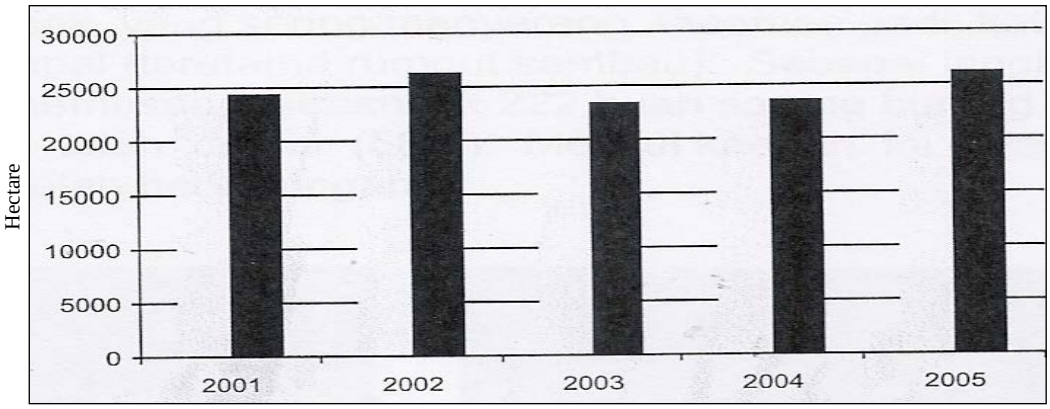
Types of rodenticides	Year						
	Wt.	1981	1985	1990	1994	1995	1996
Zinc phosphide	Kg	2129	2255	-	-	-	-
Coumatetralyl	Kg	355	1275	-	-	-	-
Brodifacoum (Matikus®)	Kg	745	1862	2380	456	1666	600
Warfarin (Yasomin®)	Kg	-	-	350	250	-	-
Warfarin (Tikumin dust®)	Kg	-	250	150	-	-	250
Chlorophacinone (Drat EC®)	Kg	-	55	16	-	-	-
Chlorophacinone (Drat Bait®)	Kg	-	-	300	713	487.5	322.5
Bromadiolone (Ebor 401®)	Kg	-	-	638	370	355.2	784

With respect to the performance indicators, some of them were able to show positive results that IPM was being adopted successfully. These indicators included;

- yield per granary area showed high levels of yield in the MADA granary and in KADA, only the Merdeka Farm had similar results.
- the insecticides and also the rodenticides usage levels were decreasing over the years in the MADA granary.

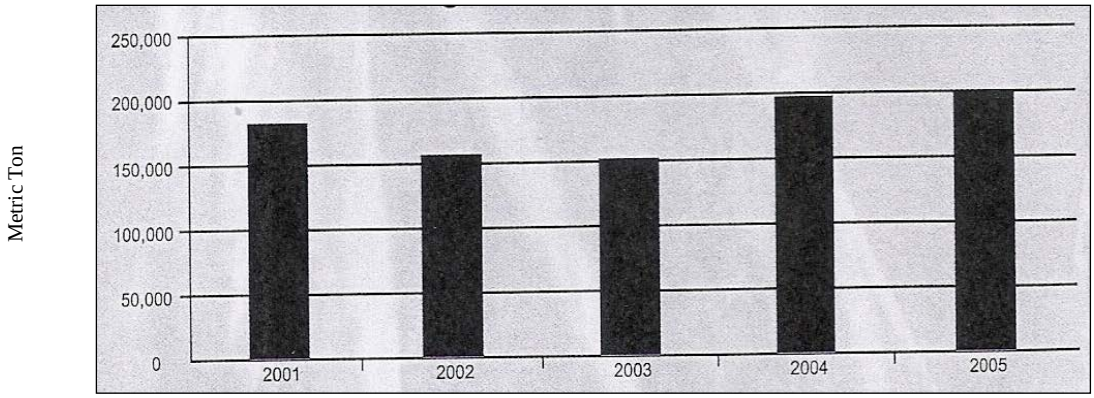
In 2007, a re-visit was conducted by the researcher. The researcher managed to secure additional information on the performance indicators from the rice granaries. Some of the additional information included ; the yield per hectare (both the main season and the off season) from KADA, inclusive of the Merdeka Farm in KADA, as well as the yield per hectare from the MADA granary. These were depicted in the Tables below.

Table 4.23: KADA – Acreage of Rice Cultivation (2001-2005)



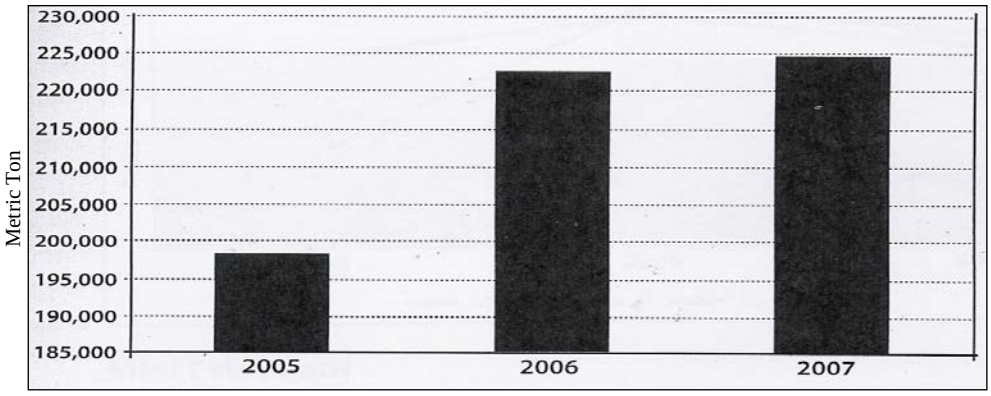
In KADA, the average acreage of land that was toiled for rice cultivation remained relatively constant over the years of 2001 till 2005.

Table 4.24: KADA – Total Yield (2001-2005)



The total yield over the years 2001 till 2003 was indicative of relatively moderate growth except for the years of 2004 and 2005, where a higher than average increase was noticed. All this was indicated in Table 4.24 above.

Table 4.25: KADA – Total Yield (2005-2007)



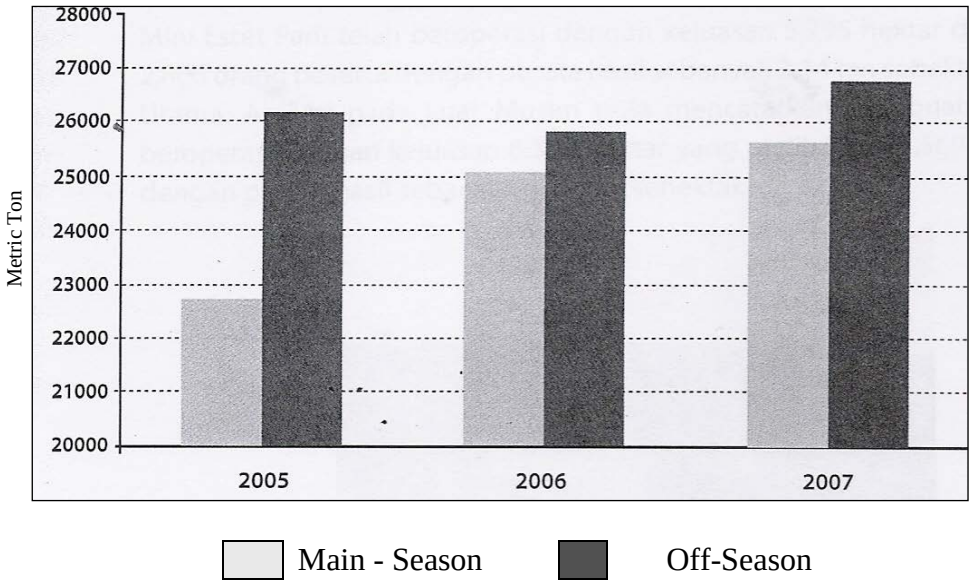
Continuing from the yield level of Table 4.25, it was noticed that KADA's yield for the years 2006 and 2007 showed exceptional growth, as compared to the years 2001 till 2003. This was indicated in Table 4.24 above.

Table 4.26: KADA – Acreage of Rice Cultivation (2003-2007)

Year	Total Acres	Average Yield	Planting Intensity	Total Output (ton)
2003	40,786	3.71	130	151,581
2004	45,134	4.26	143	192,209
2005	48,852	4.08	155	198,367
2006	50,852	4.38	162	222,745
2007	52,414	4.28	167	224,739

Table 4.26 showed an increasing amount of total land acreagae utilised for rice cultivation over the period of 2003 till 2007, ranging from 40,786 hectares to 52,414 hectares. Additionally, there was an increasing trend in the average yield per hectare for the same period, ranging from 3.71 tons per hectare to 4.28 tons per hectare. This could be indicative of greater success in the diffusion of IPM practices with respect to its latest technology and innovation.

Table 4.27: KADA – Total Yield (Main-Season & Off-Season)
(2005-2007)



From Table 4.27 above, it was observed that the acreage of land utilised for the cultivation of rice differed significantly between the two planting seasons of Main-Season and Off-Season, for the respective years of 2005 till 2007.

Table 4.28: KADA – Total Yield (Main-Season & Off-Season)
(2002-2006)

Year	Main Season			Off Season		
	Area (hectares)	Average Yield (ton/hec)	Total Production (ton)	Area (hectares)	Average Yield (ton/hec)	Total Production (ton)
2002	20,877	3.425	71,510	26,273	3.295	86,582
2003	17,363	3.630	63,034	23,423	3.780	88,547
2004	21,507	4.185	90,011	23,627	4.325	102,198
2005	22,722	4.234	96,199	26,130	3.910	102,168
2006	25,076	4.36	109,331	25,776	4.40	222,745

From Table 4.28 above, it was noticed that the Off-Season had more fields that were cultivated with rice, ranging from 26,273 hectares to 25,776 hectares over the years 2002 till 2006, as compared to the acreage dedicated to rice cultivation during the main season during the same period, viz., 20,877 hectares to 25,076 hectares. The extent of the land being used for rice cultivation would have a positive correlation to the yield that was to be produced, under normal circumstances. This was evident for most of the years in discussion, with a range of 3.295 tons per hectare to 4.40 tons per hectare for the off-season. While the main season yield had a range between 3.425 tons per hectare to 4.36 tons per hectare.

Table 4.29 KADA – Total Yield (Main-Season & Off-Season)
(2006-2008)

Year	Main Season			Off Season		
	Area (hectares)	Average Yield (ton/hec)	Total Production (ton)	Area (hectares)	Average Yield (ton/hec)	Total Production (ton)
2006	25,076	3.600	90,270	25,776	3.519	90,706
2007	25,634	3,593	92,103	26,780	3.605	96,542
2008	24,470	3.646	89,218	25,459	3.613	91,983

In addition, information was secured for the years of 2006 till 2008 for KADA. From Table 4.29 above, it was noticed that the Off-Season had slightly more rice fields that were cultivated, ranging from 26,780 hectares to 25,459 hectares for the years 2007 and 2008, as compared to the acreage dedicated to rice cultivation during the main season during the same period, viz., 25,634 hectares to 24,470 hectares. However, the difference in the yield per hectare was not significant between the two seasons of rice cultivation, viz., 3.605 and 3.613 tons per hectare for the off-season as compared to 3.593 and 3.646 tons per hectare for the main-season.

Overall, it was evident that KADA had significantly increased their yield per hectare over the years of cultivation and with the adoption of good IPM practices as advocated with its technology and innovation diffusion, among other factors.

Furthermore, a special project under KADA was the ‘Merdeka Farm’ which was mentioned earlier in the Findings Chapter. From the narration in the earlier chapter, it was discovered that the rice fields in the ‘Merdeka Farm’ were managed under a large scale farm management concept where farm lands were designed to a suitable size using high technology techniques. It

was hoped that a model of "farm development" would change the non-systematic culture into a culture that paid greater attention to the latest IPM innovation and technology to achieve higher productivity. Some of the productivity levels from the 'Merdeka Farm' were secured for the years 2002 till 2006, for both the main season and off-season.

Table 4.30: KADA - Yield per Hectare - Merdeka Farm
(Main Season)

Year	Total farm	Farm area/ha	Operation Area/ha	Total Participant	Yield/ha	Project Cost (RM)	Average Profit/ha (RM)
1996	6	243.48	209.13	990	3.26	6,274.23	947.07
1997	8	306.6	268.02	1,205	3.34	9,730.07	1,016.43
1998	9	349.78	306.88	1,340	3.37	-	1,334.29
1999	8	319.47	277.52	1,340	4.07	-	1,852.85
2000	10	454.55	398.68	1,706	3.34	-	1,134.03
2001	10	454.55	398.68	1,706	2.39	-	342.91
2002	**10**	**454.55**	**398.68**	**1,706**	**2.03**	**-**	**221.81**
2003	**12**	**532.75**	**468.66**	**2,013**	**3.34**	**16,723.61**	**924.32**
2004	**14**	**629.45**	**544.06**	**2,339**	**3.92**	**14,426.69**	**896.34**
2005	**16**	**719.45**	**622.13**	**2,609**	**-**	**16,458.98**	**-**
2006	**17**	**733.99**	**612.99**	**2,524**	**3.91**	**-**	**-**

It could be observed that the yield per hectare for the years 2002 till 2006 did increase significantly, with the exception of 2005 in which the floods were detrimental to the rice crop production levels.

Table 4.31: KADA -Yield per Hectare - Merdeka Farm
(Off-Season)

Year	Total Farm	Farm Area/ha	Operation Area/ha	Total Participant	Yield/ha	Project Cost (RM)	Average Income/ha (RM)
1996	6	276.29	238.66	1,115	3.10	26,473.53	1,134.80
1997	8	319.47	277.52	1,340	3.55	18,856.58	1,695.12
1998	9	319.47	277.52	1,340	2.90	-	1,015.44
1999	8	319.47	277.52	1,340	3.06	-	1,260.84
2000	10	424.24	369.32	1,706	3.35	-	1,342.23
2001	10	424.24	369.32	1,706	2.90	-	924.43
2002	**10**	**355.85**	**310.26**	**1,893**	**2.52**	**16,921.09**	**726.90**
2003	**12**	**582.04**	**509.88**	**2,251**	**3.96**	**-**	**1,201.19**
2004	**14**	**629.45**	**586.57**	**2,479**	**3.60**	**29,952.86**	**900.44**
2005	**16**	**-**	**-**	**-**	**-**	**-**	**-**

Information was secured on the ‘Merdeka Farm’ for the off-season for the years 2002 till 2005 and as was observed that there was significant increase in the yield per hectare for this time period. However, for 2005, there was no information as there was the natural catastrophe of the floods in that area.

Additionally, the same performance indicator of yield per hectare was secured for the MADA granary for the years 2002 till 2007, as shown in Table 4.32 below. It could be observed that the yield per hectare had been progressively increasing over the years. This could be due to the adoption of good IPM practices as endorsed by its techonology and innovation.

Table 4.32: MADA - Average Yield per Hectare

Year	Total Planting area	Yield / ha	Total Productivity
2000	51,086	3.96	202,872
2001	48,767	3.78	184,369
2002	**47,150**	**3.36**	**158,092**
2003	**40,786**	**3.71**	**151,581**
2004	**45,134**	**4.26**	**192,209**
2005	**48,852**	**4.07**	**198,367**
2006	**50,852**	**4.38**	**222,745**
2007	**52,414**	**4.29**	**224,739**

In Table 4.33 below, it could be observed as to the increasing trend in the average yield per hectare (in kilos) from the years 2002 till 2007 (Main Season) with the exception of 2006 where a large area was affected by floods. This led to a poor production level for the main season. This is another positive sign that there could be better adoption of good practices of IPM technology and innovation for rice production.

Table 4.33: MADA - Average Yield for the Main Season

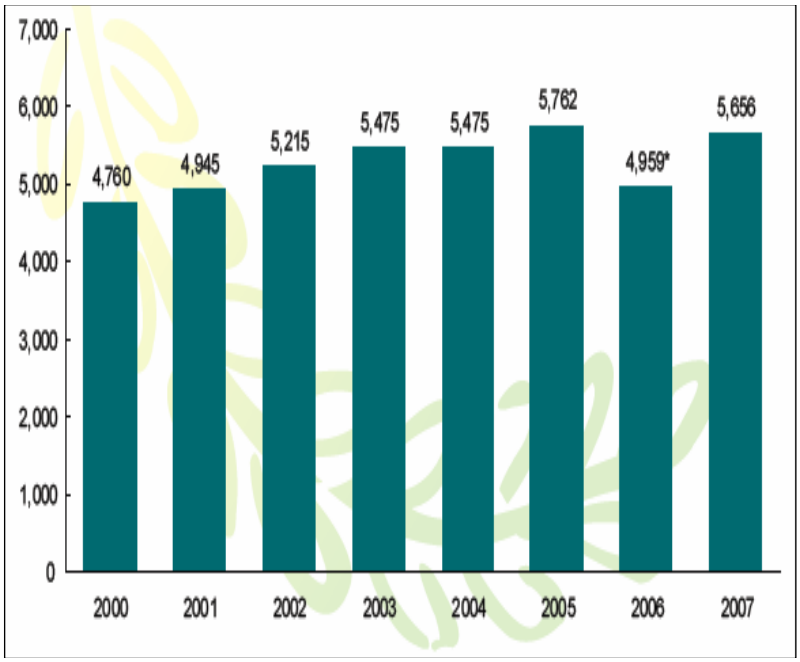


Table 4.34: MADA - Average Yield per Hectare
for the Main Season (2000-2007)
and Off Season (2001-2007)

Main Season (2001-2007)	Off Season (2000 – 2007)
1/2002 – 5.8 tan/hek	2/2001 – 5.4 tan/hek
1/2003 – 6.2 tan/hek	2/2002 – 5.6 tan/hek
1/2004 – 6.3 tan/hek	2/2003 – 5.7 tan/hek
1/2005 – 6.9 tan/hek	2/2004 – 6.2 tan/hek
1/2006 – 6.4 tan/hek	2/2005* - 4.3 tan/hek
1/2007 – 6.1 tan/hek	2/2006 – 5.8 tan/hek
	2/2007 – 5.7 tan/hek

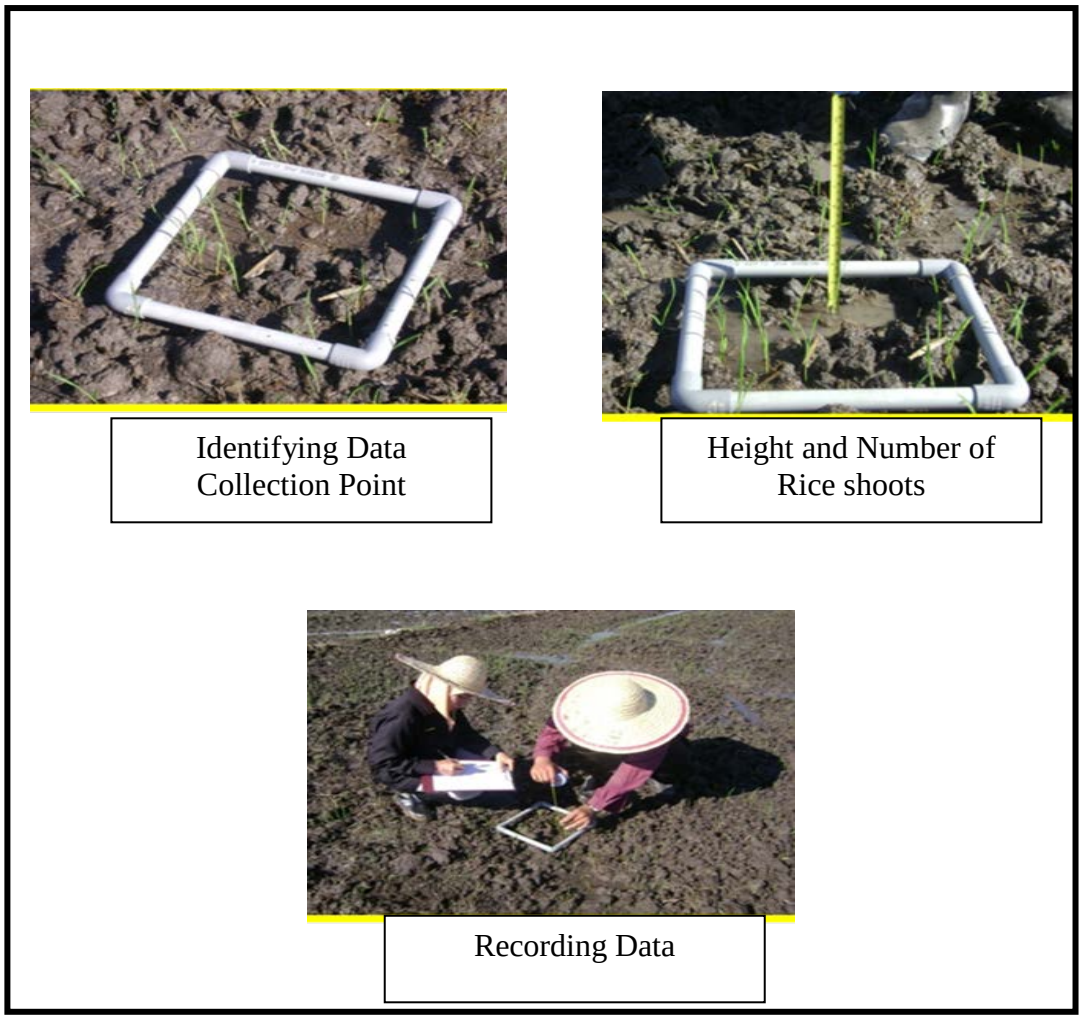
Table 4.34 above displayed the average yield for both the seasons in MADA. Overall it could be observed that the yield per hectare for the main season was significantly higher than the yield per hectare for the off-season, for the years 2002 till 2007, with the exception of 2006 where the MADA granary region was hit by floods. However, it could also be observed that there was a significant increase in the average yield per hectare over the years of 2002 till 2007, for both seasons, indicating an increase in rice productivity. This could be due to the fact that the farmers in this granary were adopting better rice production practices as endorsed by the IPM technology and innovation.

In addition to the latest statistics that was secured, the researcher's interview discovered that MADA had adopted a new dimension of farming called 'Precision Farming'. The department head elaborated that since the gap between potential and actual yield was caused by improper farm management practices, what was critically needed was improved crop cultivars, such as ;

improved tillage, improved water management, improved fertiliser management, improved weed management and improved integration of practices to suit local conditions, viz., `precision farming'.

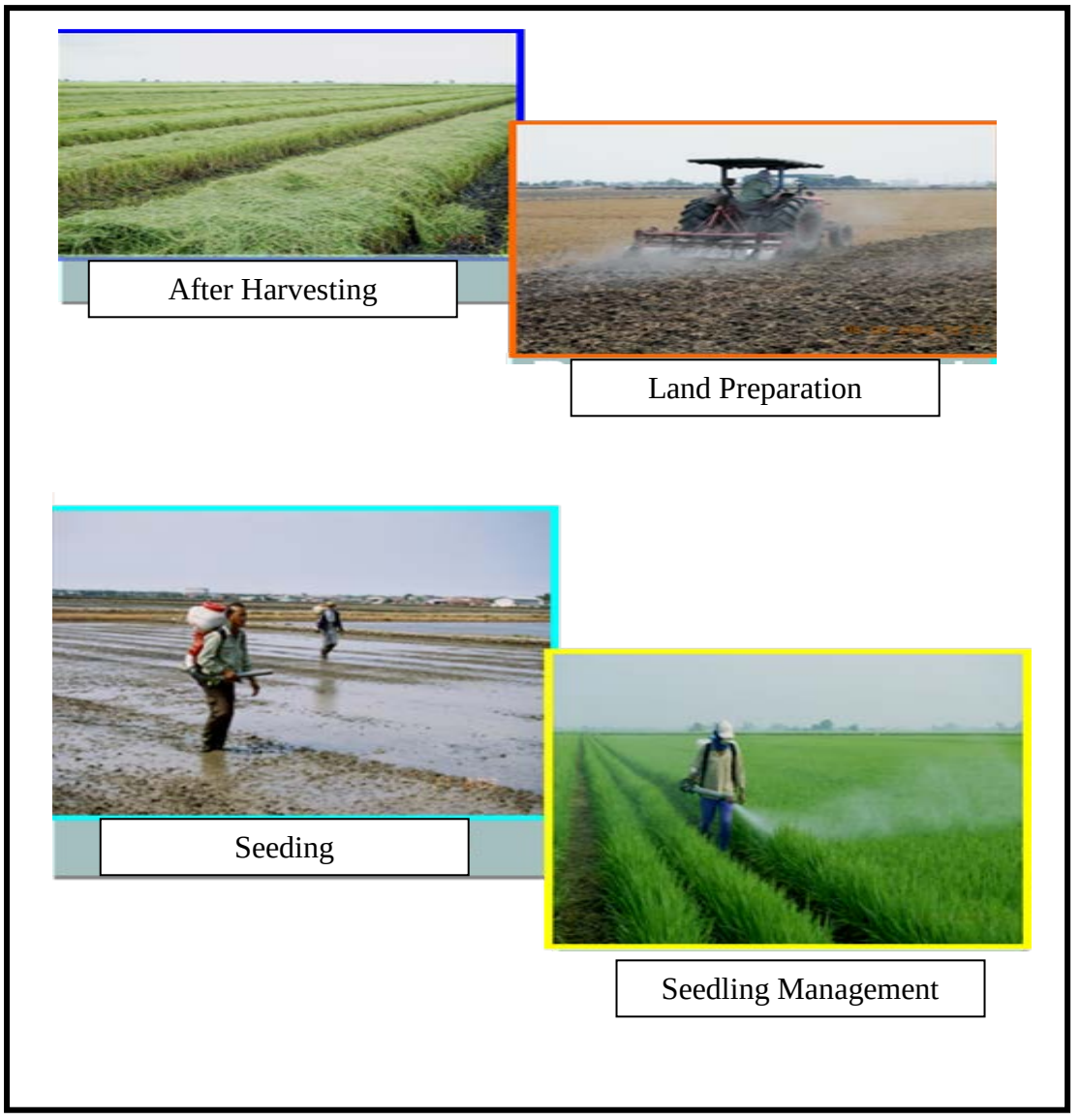
The general objectives of 'precision farming' were; to optimise the use of soil and water resources and chemical inputs (fertiliser and pesticides) such that it improved farm profitability and protected the environment. Figure 4.30 showed some of the stages that were undertaken by the 'precision farming'. These included the following; identification point of the piece of rice plot that would be used in the study for control purposes, the continuous measurement of the growth rate of the rice plant and the process of recording of data for the study on the effectiveness of 'precision farming'.

Figure 4.31: Precision Farming Study



In Figure 4.31, a pictorial display of the four key processes of 'precision farming' were highlighted, namely; the harvesting of the previous yield, the preparation of the land with mechanical tractors, the process of seeding as done with the use of motorised seeders as well as the management of the seedlings during its growth period, via the spraying of fertilisers as well as the necessary pesticides.

Figure 4.32: Precision Farming Process



'Precision farming' specifically referred to a set of technology which allowed farmers to make use of the variability in their farming environment and optimise the management of water, nutrients and other required inputs. An assured supply of nutrients that were required was applied in environmentally acceptable ways. All these helped to support the effort to achieve

sustainability in rice tropical cropping systems in an economical way. The role of nutrients cannot be underplayed. They were needed to produce crops at a reasonable rate of yield increase, which in the past had approximated 2-3% per year. In Asia, 24% of the increase in rice production between 1985 and 1980 was estimated to result from better crop nutrition due to fertiliser input. By 1995, nearly 40% of all fertilisers produced worldwide were used in Asian agriculture; 60% of the fertiliser used in Asia was applied to rice. Additional research was conducted to study the greater yield potential of modern cultivars as well as to reduce potential adverse effect such as ground water contamination from excessive nitrogen inputs that exceeded crop needs. This is one of the key tenets of 'precision farming'.

Another key tenet of 'precision farming' was water management. Water being an indispensable ingredient for all crops, was critical for rice production with an estimation of 5000 litres being used to produce 1kg of rice. As water was increasingly becoming a scarce resource, action needed to be taken to make better use of existing water irrigation infrastructure. In the rain fed lowland ecosystem, rainfall amount and frequency were difficult to predict. Hence risk management strategies were in need of being developed. Work was also needed to characterise the biophysical and socioeconomic resources of the principal sub ecosystems to use Geographic Information System (GIS). This system would help to design crop models, calculate probabilities of stress occurrence and develop appropriate systems for sustainable exploitation of the scarce natural resources.

In conclusion, it was apparent that evidence from this research study supported the view of the exploratory model which highlighted the six key variables. These six key variables were responsible to enhance the efficacy of the IPM technology and innovation dissemination in

MADA and KADA. From this study of the two largest rice granaries, it was discovered that some of these six key variables were prevalent in MADA and some were in KADA. Performance indicators were used to validate these findings, together with the latest IPM practices that were adopted in MADA and KADA were enumerated in this chapter.