3 RESEARCH METHODOLOGY

3.1 Introduction

The main issue of this exploratory research was the efficacy of implementation of IPM technology and innovation for rice production in the two largest granaries in Malaysia. To explore this, various sources of information were traced using multiple research procedures, as explained by Trochim, and Donnelly (2007). They described the entire cycle of the research process in detail. Some of the processes included; the conceptualization stage, the design stage, different methods of measurement, multiple types of analysis, systematic reporting and experimental design. In this chapter, a description and summary of the sources of information as well as the methodology employed in this exploratory study is narrated. These included; the research design utilised, the research questions, the questionnaire designed, the selection of respondents, the experience survey, the process of secondary date collection, the pilot study conducted, the case-study done, the in-depth interviews conducted and also the focus group that was implemented. As the research methodology process was an iterative one, refinements were made along the way, so as to enhance the quality of this research.

3.2 Research Design

The research design process was hinged profoundly on the type of research that was to be conducted, viz., in this case, exploratory research. This type of research was usually chosen when the problem understudy has not been clearly defined. It is also referred to as a preliminary

research that is conducted to increase the understanding of a concept that helps to clarify the exact nature of the problem to be solved, or to identify important variables to be studied. The goal of exploratory research is to formulate problems more precisely, clarify concepts, gather explanations, gain insight, eliminate impractical ideas, and form hypotheses (Russell, 2006). In addition, Zikmund et.al., (2009) concurs that exploratory research helps the researcher to crystallize the definition of a problem, to diagnose a situation, to screen between alternatives and to discover new ideas. Exploratory research, as promulgated by Babbie (1989), helps to determine the best research design, data collection method and selection of subjects. The results of exploratory research provide significant insight into a given situation as they give some indication as to the "why", "how" and "when" something occurs. Used in the early stages of the decision-making process, exploratory research is used to assess the situation in hand with the minimum cost and time possible. Versatility and a wide-ranged approach to the preliminary investigation are the main benefits of this genre of research.

According to Russell (2006) exploratory research is used in many social science circles to "seek and find out how people get along in the setting under question, what meanings they give to their actions, and what issues concern them. The goal of exploratory research is to learn 'what is going on here?' and to investigate social phenomena without explicit expectations." The key purpose of exploratory research is to gather preliminary information that will help define problems and suggest hypotheses. The three main objectives of exploratory research are exploratory, descriptive and explanatory. Exploratory research is used when the topic or issue is new and when data is not extensive. Exploratory research is flexible and can address research questions of all types. Exploratory research is often used to generate formal hypotheses. In the social

sciences, it is thought of as a perspective, a way of approaching and carrying out a social study, as narrated by Stebbins, (2001). It helps move current methodological discussions beyond listing the pros and cons associated with a set of tried, oversimplified, either-or choices-qualitative and quantitative, inductive or deductive, descriptive or predictive. Here, exploratory research enables the research to create a long, cumulative, choice-laden, and interest-governed process of undertaking research.

Additionally, exploratory research is used extensively in social science notably in the area of social and psychological life (Zikmund et.al., 2009). Here it is described as a broad-ranging, purposive, systematic, a prearranged undertaking, that is designed to maximise the discovery of generalisations leading to description and a deeper understanding. Such exploration is a distinctive way of conducting science, using a special methodological approach where an intense and pervasive personal orientation of the explorer is employed. Some of the results from using exploratory research include; the emergent generalizations which are highly varied, the facts are descriptive, there is a detection of concepts, structural arrangements, social process and beliefs systems that are found using exploratory research.

Generally, exploratory research techniques simply involve conversations between a researcher and the people being studied such as consumers, employees, management or competitors. Although the researcher may guide the conversation across certain issues, the questioning is usually informal and semi-structured. For most purposes, exploratory research produces qualitative data (Zikmund et.al., 2009). This is done through a process of asking the right questions of the right people in the right way to produce generalisable results. These facets of research are often uncovered through carefully conducted qualitative research, which explores

decision problems using commonly used exploratory research techniques. The authors go further to highlight these techniques. These include;

- experience surveys – here the research focus on asking experts about the topic that is under study using formal and informal discussions that involve talking with knowledgeable individuals, both inside and outside the organization, who may provide insights into the problem.
- secondary data analysis – this provides a quick source of background information to the researcher. It comprises data that have been gathered for some other objective than the current research objective
- case studies – this category enables the researcher to intensely investigate one or a few situations which are similar to the present research problem
- pilot studies - this enables the researcher to accumulate information for qualitative analysis surveys, using a limited number of respondents and often employing less rigorous sampling techniques
- focus-group – these are in-depth discussions that are unstructured and free-flowing to help clarify and understand the problem and issues involved. These small groups usually consist of 8 to 12 participants, which are led by a moderator and are generally limited to one particular concept, idea, or theme. The general idea is to have what one person has said that will generate thoughts and comments by others, therefore creating group dynamics. The interplay of responses will yield more information than if the same number of persons had contributed in individual interviews.

According to Tesch (1990), exploratory research is being integrated into the field of qualitative research, notably in the process of de-contextualising and re-contextualising theory building analysis. Here the entire process is repeated when the research is predominantly exploratory research and the existing system being investigated, needs further development.

Besides utilising exploratory research in the field of social science, this genre of research has become the new vocabulary that is being integrated into research and practiced across disciplines. Some of the disciplines in which exploratory research is used are explained here. One example, according to Portney & Watkins (2007) is health care, where its expanded content is related to clinical decision making and it reflects the most current changes in the field of clinical research in rehabilitation and medicine.

Gruber (2011) also undertook an exploratory research study in the discipline of service management. He used the qualitative laddering interviewing technique, with the aim of gaining a deeper insight of the so-called micro structures of complaining customers that helped to reveal the cognitive structures of complaining customers.

In an IT discipline study conducted by Pollard and Carter-Steel (2009), the exploratory research methodology was used to determine the “best practice” framework to improve IT service management processes. Part of the methodology utilised was case-studies of four organisations, two in United States and two in Australia. The cases demonstrated a mix of implementation justifications and strategies. Critical success factors as suggested in the literature were compared against those attributed to these successful IT Infrastructure Library implementations.

Exploratory research was also utilised in the medical discipline as studies by Hansen (2009) when he studied the factors affecting the implementation of a strategy within the hospital environment. The strategy that was investigated was the implementation of the Quick Response Team in hospitalization units that were pursuing quality and safe services to the patients. The qualitative exploratory research methodology was adopted in this study using in-depth interviews with a single case study within a private hospital located in Brazil.

In the discipline of security risk management, exploratory research methodology was used by Zafar (2010). His study investigated differences in perception between layers of management (executive, middle, and lower) and staff with regards to the influence of critical success factors on security risk management effectiveness. His research study encompassed an in-depth case study that was conducted on a Fortune 500 company in USA.

In the general areas of marketing and in the specific area of relationship marketing, the exploratory research methodology was utilised by Wang & Chen (2009) to explore the understanding of 'guanxi', both from the academia and from the practitioners. In their study, they used qualitative research methods such as content analysis and focus group to get a thorough feedback that guided them in their development of a native commercial 'guanxi' concept scale.

In the health industry, the exploratory study was utilised to explore users' perspectives about the electronic health records (EHR) implementation process and impact in a community health centers (CHC) network. Faced with an increasingly complex patient population and growing

demand for services, (CHCs) are recognizing that (EHRs) may help their efforts to improve efficiency in care delivery. Yet little is known about the benefits, challenges, and specific impacts of EHR implementation in the often resource-constrained CHC environment, especially from users' perspectives.

In this exploratory research, the research design incorporated multiple methods, namely; interviews, case studies, on-site visits to the offices of the agricultural extension officers, on-site visits to the farmers' associations and a review of secondary documents. Data collected through multiple methodologies represented essential components of most research diagnosis. Weick (1979, p.189) stated that "if simple processes were applied to complicated data then only a small portion of that data would be captured. Accurate registering of data would be guaranteed if there was a good match of research processes to the characteristics of their inputs". A single methodology would only be able to capture a small slice of the complex real issues that were studied. Analyses of complex systems required a larger variety of data collection methodologies in order to mirror the complexities that they were attempting to describe.

One of the strongly recommended and widely documented research methods was the triangulation methodology. This offered an opportunity to improve the research diagnosis and accuracy of the responses that were received. This was done by synthesising the results from multiple scientific methods into a coherent and valid interpretation. In the social sciences arena, the use of the triangulation methodology could be traced back to Campbell and Fiske (1959) who developed the idea of "multiple operationalism". They proposed that the convergence between two methodologies should be used in the validation process to enhance the validity of the results and not treated as what Bouchard (1976: 268) referred to as a "methodological artefact".

According to Denzin (1989), the triangulation methodology had vital strengths and encouraged productive research as it could stimulate better definition and analyses of problems in organisational research. It also captured a more complete, holistic and contextual portrayal of the units being measured in the research study. This was especially notable when multiple measures were used to uncover differences which may otherwise be neglected under a single study method. It further eliminated the engagement of the same kind of sterile, unproductive, unimaginative investigations which had long characterised most research.

The triangulation methodology was often labelled as the "between methods" as it represented a vehicle for cross validation through two or more distinct methods which were found to be congruent and yield comparable data. The effectiveness of the triangulation methodology rested on the premise that the weaknesses inherent in each single method would be compensated by the counter-balanced strength of another method. This allowed researchers to become more confident of their interpretations due to the strength of the multi-method design.

For organisational researchers, this methodology involved the use of multiple methods to examine the same dimension of a research problem (Denzin, 1978:302), which is by using the quantitative and qualitative methods. Qualitative methods were given an elevated status as it played a prominent role and proved to be the thread that linked the benefits by eliciting data and suggesting conclusions to which other methods would be blind. Besides heightening the qualitative methods to their deserved prominence, it also demonstrated that quantitative methods could and should be utilised in complementary fashion.

Additionally, according to Phillips (1971), the triangulation methodology demanded a greater level of creativity from its users, a higher level of ingenuity in collecting data and a keener intensity of insightful interpretation of data. It also played other constructive roles such as stimulating the creation of inventive methods and discovering new ways of capturing a problem as opposed to the conventional data-collection methods. One of the biggest benefits of this methodology was that researchers were likely to sustain a profitable closeness to the situation which allowed greater sensitivity to the multiple sources of data.

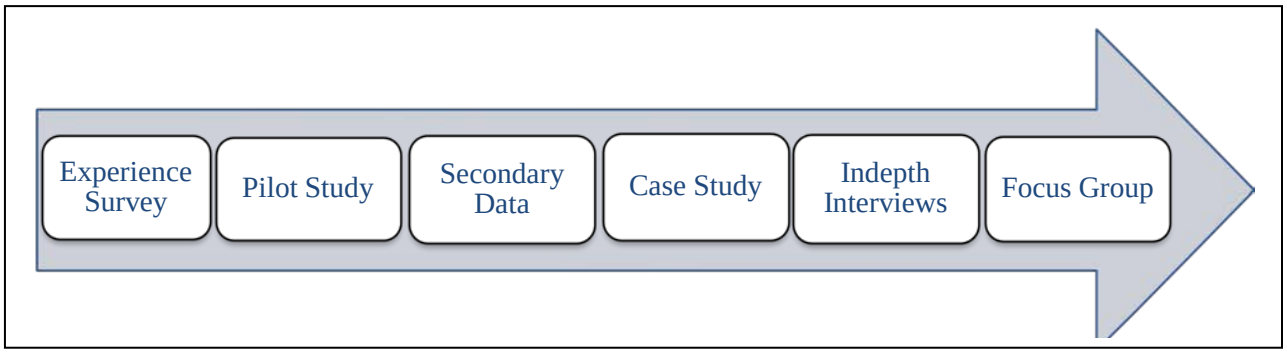
However, the triangulation methodology had certain shortcomings, the most prominent being, replication. Replication had been largely absent from most organisational research although this was considered to be a necessary step in scientific research. Replicating a mixed-methods package that included idiosyncratic techniques would be a nearly impossible task. Another key shortcoming was that multi-methods were of no use when the "wrong" question was used, notably when the research was not clearly focused theoretically or conceptually and would not produce a satisfactory outcome. Similarly, the triangulation methodology should not be used to legitimate a dominant method such as either the quantitative or qualitative methods as those methods would become mere window dressings for the other resulting in the design becoming inadequate or biased.

3.3 Research Flow Process

To explore the diffusion process of IPM at a more profound level, a strategy was put in place for this exploratory research. Initially, an overview was made as to various locations of the study, viz., Ministry of Agriculture Head office in Kuala Lumpur, MADA in Kedah and also KADA in

Kelantan. Next in the process flow was the identification of the respondents in all these three location. Some of them comprised the experts, namely, the heads of departments and also the agricultural extension officers. Letter were sent out detailing the intention and also to secure the possible dates for expert surveys to be done, coupled with the pilot study, secondary data collection, indepth interviews for the two case studies and also the focus group interviews. A diagrammatic description is made of the whole research process flow conducted over the two time periods of 2001 and also 2007. These are depicted in Figure 3.1 and also Figure 3.2. In addition, a table detailing the underlying research objectives of each research activity together with the personnel involved during both the time period are displayed in Table 3.1 and also 3.2 below.

Figure 3.1 : Research Flow Diagram : 2001



Research Activity Description	Research Objectives	Personnel Involved
Experience Survey		

with International Rice Research Institute Steering Committee	• Brainstorm draft questionnaire • Finalise Pilot Study questionnaire • Agree on 'weight age' on selected questions	• 8 representatives from various Asian countries who were experts in the field of Integrated Pest Management Technology and Innovation practices • Countries included; Vietnam, Thailand, The Philippines, Indonesia and Malaysia

Table 3.1 : Research Flow Description : 2001

Experience Survey with Ministry of Agriculture officials	• To secure background information on the current IPM practices adopted in the rice industry in Malaysia	• 6 representatives from the Head Office in Kuala Lumpur
Pilot Study with Ministry of Agriculture	• Draft questionnaire tested with officials from Ministry of Agriculture officials	• 6 representatives from the Head Office in Kuala Lumpur
Pilot Study at KADA	• Draft questionnaire tested with KADA agricultural extension officers	• 12 representatives from the KADA extension department
Secondary Data Analysing recorded minutes of meetings in Ministry of Agriculture	• To secure an understanding on the current IPM practices adopted in the rice industry in Malaysia	

Secondary Data Analysing recorded minutes of meetings in MADA	• To secure an understanding on the current IPM practices adopted in MADA rice granary + some Performance Indicators	
Secondary Data Analysing recorded minutes of meetings in KADA	• To secure an understanding on the current IPM practices adopted in KADA rice granary + some Performance Indicators	
Case Study and In depth Interviews conducted at MADA	• To secure an understanding on the current IPM practices adopted in MADA with respect to the KAP of the agricultural extension officers	• 85 MADA agricultural extension officers

Case Study and In depth Interviews conducted at KADA	• To secure an understanding on the current IPM practices adopted in KADA with respect to the KAP of the agricultural extension officers	• 21 KADA agricultural extension officers
Focus Group interviews conducted with Heads of Departments in MADA	• To secure an understanding on the current IPM practices adopted in MADA with respect to the six key variables or critical success factors	• 4 Heads of Departments
Focus Group interviews conducted with Heads of Departments in KADA	• To secure an understanding on the current IPM practices adopted in KADA with respect to the six key variables or critical success factors	• 2 Heads of Departments

3.3.1 Research Flow Process : 2001

To explore the diffusion process of IPM at a more profound level, a strategy was put in place for this exploratory research. Initially, an overview was made as to various locations of the study, viz., Ministry of Agriculture Head office in Kuala Lumpur, MADA in Kedah and also KADA in Kelantan. Next in the process flow was the identification of the respondents in all these three location. Some of them comprised the experts, namely, the heads of departments and also the agricultural extension officers. Letter were sent out detailing the intention and also to secure the possible dates for expert surveys to be done, coupled with the pilot study, secondary data collection, indepth interviews for the two case studies and also the focus group interviews. A diagrammatic description is made of the whole research process flow conducted over the two time periods of 2001 and also 2007. These are depicted in Figure 3.1 and also Figure 3.2. In addition, a table detailing the underlying research objectives of each research activity together with the personnel involved during both the time period are displayed in Table 3.1 and also 3.2 below.

- Experience Survey

An initial exploratory research step in this study was to conduct an experience survey with the International Rice Research Institute Steering Committee. The panel members of the Steering Committee were notable authorities in their own respective fields, especially in exploring issues in facilitating the diffusion process of IPM innovation, coupled with analysing the stifling factors that were inhibiting the successful implementation of new innovative IPM remedies. These experts came from countries such as Vietnam, Thailand, Indonesia, The Philippines and also the host nation, Malaysia. Malaysia was represented by officials from the two largest rice granaries, officials from the Ministry of Agriculture and as well as researchers from University of Malaya.

The meetings were conducted at University of Malaya in May 1999, in Kuala Lumpur. The objective of doing this experience survey with them was to brainstorm the preliminary questionnaire. The panel of experts deliberated all the constructs and all the variables were heavily scrutinised. They then helped to finalise the pilot study questionnaire. These experts also added the 'weightage' on selected questions of the questionnaire.

This was followed through with the experience survey conducted with 6 representatives from the Ministry of Agriculture Head Office in Kuala Lumpur. The 6 officials represented the heads of the agricultural units, anthropologists, weed specialists, agricultural heads of departments and agricultural research officers. Through this procedure, a comprehensive overview of the structure and processes of the Rice IPM in Malaysia was obtained. Some of the information acquired included; the diffusion process of IPM innovation, the IPM supportive activities, a summary of IPM technology and a highlight on IPM implementation issues and problems. The main objective of this process in the research methodology was too secure background information on the current IPM practices adopted in the rice industry in Malaysia.

- Pilot Study

According to Sudman & Bradburn (1982), pre-testing was a highly touted part of questionnaire design as it was the procedure warranted to identify construction defects and to test the structure and clarity of the questions. The pre-test helped to screen the questionnaire to see how it worked and whether changes were necessary before the actual survey commenced. The pre-test provided a means of catching and solving unforeseen problems in using the questionnaire, such as in the phrasing and sequencing of questions. Linguistic and cultural differences often complicated the task of developing a questionnaire, thus making pre-testing indispensable. The pre-test enabled the researcher to improve the wording of the questionnaire, corrected and improved the translation of technical terms; checked the accuracy and adequacy of the questionnaire's instructions; eliminated unnecessary questions; added necessary ones; and aided the researcher to estimate the time needed to conduct the in-depth interview.

This step was done after the draft questionnaire was finalised by the International Rice Research Institute Steering Committee. Next the research questionnaire was tested with six officials from Ministry of Agriculture. A second pilot test was conducted with 12 representatives from the KADA extension department, to ensure that the wordings were clear and not ambiguous to them. Then the research tool was edited and upgraded after the pilot study and was made ready for the full-scale in depth interviews to be conducted at both the rice granaries.

As a result, the preliminary questionnaire or the prototype questionnaire was analysed by the panel of rice experts. . New constructs to measure the influencing variables of Knowledge,

Attitudes and Practices of the agricultural extension officers were proposed. Ensuing this, a new questionnaire was designed under the endorsement of the panel of global rice experts. This new questionnaire was then pre-tested with a group of 5 agricultural extension officers from MADA to gain their feedback on the construction, language, clarity and validity of the questions. From their response, refinements were made to the initial questionnaire so as to facilitate better understanding and comprehension of elements being tested in the questionnaire. The amended data collection tool was then launched to encompass the agricultural extension officers from the two largest rice granaries in Malaysia.

- Secondary Data

An analysis was conducted on the recorded minutes of meetings in the Ministry of Agriculture, with the objective of securing an understanding on the current IPM practices adopted in the rice industry in Malaysia. This research activity was repeated for MADA and KADA with the same objective of understanding the situation in their respective rice granaries.

The use of secondary information through the use of archival data was regarded as an unobtrusive research methodology. Documents were an important source of information and the review of available documents and records provided insight into the constructs being researched. Some records and reports which were referred to during the interviews were traced and they proved to be critical, such as the brochures and leaflets disseminated to the farmers by the agricultural extension officers. Minutes of the committee meetings provided an insight as to why certain decisions were undertaken and who were the main parties involved in those decisions. The

advantage of archival contemporary documents was that they did not change with hindsight, as peoples' memories did. But sadly, they were often disappointing because they usually recorded only decisions, rather than the consideration which led to the decisions.

To supplement a better appreciation of the flow of IPM development, a review of the minutes from the largest rice granary in was performed, viz, MADA (Muda Agriculture Development Authority) from the year of 1995 till 2001. The minutes emphasised meetings conducted between the diverse rice IPM related authorities, such as; the MADA granary, IRRI (the International Rice Research Institute based in The Philippines), the local universities, the Ministry of Agriculture, the Ministry of Health, BERNAS (the Malaysian Rice Authority), the banks, FAO (Food and Agricultural Organisation) and the other local units promulgating IPM technology.

Although the disadvantage of archival data was that it contained a lot of information not directly related to the constructs of the research objectives, Webb and Weick (1979) recommended that archival data should be incorporated when studying organisational issues. Archival data assisted the triangulation process by providing documentation of the history and maturation of organisational systems. Archival data allowed cross-sectional data collected by other methods to be placed in a longitudinal context. Additionally, archival data could corroborate or refute subjective data collected through interviews and questionnaires. Some of the documents reviewed included official records, correspondence, reports and newspapers accounts. All these supplemented the information gained through the interviews part of the research methodology.

- Case Study and In depth Interviews

Exploratory multiple case study research design was chosen as case studies are particularly useful for problems where the context of action is critical (Benbasat, Goldstein & Mead, 1987), and the research and theory are at formative stages or call for a revision of understanding (Lee, 1991). Using this approach, researchers can gain a rich understanding of the context of the research. In addition, the case-study method provided the opportunity to ask penetrating questions and to capture the richness of organisational behaviour, but it is recognized that the conclusions drawn may be specific to the particular organisations studied and may not be generalisable (Gable, 1994; Yin, 1994).

The case studies' contents were analysed through an analysis of the interview transcripts to identify patterns and summarise the main characteristics of approach and to select quotations that were supportive of the patterns and themes identified. In describing and comparing the two cases, the salient points from the interviews of MADA and KADA were detailed and illustrated with quotations from the Heads of Department or Units and also the agricultural extension officers, who were interviewed.

The case study and in depth interviews were conducted with the agricultural extension officers from MADA and KADA. The key objective was to secure an understanding of the current IPM practices adopted in MADA and KADA with respect to the KAP levels of the agricultural extension officers. A total of 85 agricultural extension officers from MADA were interviewed and 21 agricultural extension officers from KADA. All their responses were analysed under the categories of Knowledge, Attitude and Practice. These were reported in Chapter 4, Analysis and Findings chapter.

- Focus Group Interviews

To secure an understanding on the current IPM practices adopted in MADA with respect to the six key variables or critical success factors, the four Heads of Department from MADA and the two Heads of Department from KADA were interviewed. The main objective of this exercise was to extract narratives from the Heads regarding the six key variables of this research. Their responses to the questions were secured through face-to-face interviews done in a group setting. Kerlinger (1986) strongly believed that interview data aided the triangulation process as it provided insight into the salience and meaning of the specific key, influencing and dependent variables being studied. Focus group interviews mostly contained the open-ended type of questions as they provided a frame of reference for the respondents' answers. These interviews also provided the researcher with the opportunity to establish a good rapport with the Heads of Department. Additionally, there were no restrictions placed on the manner in which the respondents answered, as the open-ended questions were flexible in nature. The loosely guided structure helped make the interviewing process focused on the research problem.

According to Warwick & Lininger (1975), this method was highly appropriate when the purpose of the study was to explore complex issues in considerable depth. This was also reiterated by Burgess (1982, p.107), who said that the in depth interviews done for focus groups, afforded "the opportunity to probe deeply, to open dimensions of the problem and to secure a vivid, accurate and inclusive account based on personal experience". This deeper level analysis enabled the researcher to penetrate below the level of conscious awareness or behind the individual's social facade (Oppenheim 1966).

Additionally, Jones (1998) added that open-ended questions tended to provide greater freedom for the respondents to answer in their own terms rather than within the tramlines of set alternatives found in the 'closed' questions of a questionnaire. There was also the advantage that the richness and spontaneity of information collected by this method was higher than other methods (Oppenheim, 1966). Patton (1990) suggested that all the responses from the respondents should be transcribed and coded, for quick retrieval and summary making. This was also echoed by Miles & Huberman (1994), who recommended jotting down notes as soon as the interviews were completed. That would serve as a memory aid especially when full field notes were constructed, preferably on the same day.

After each focus group interview a "thumbnail sketch" was recorded of the responses to the questions. This procedure helped to enhance the rigor of qualitative methods, viz., by giving recognition to the respondents' facial expressions, tone of voice and hesitations when they responded. Hence this gave a reflection of the "rich menu of alternative possibilities available within qualitative research" (Patton, 1990, p.65).

The qualitative summary of the focus group interviews were descriptive, incorporating expressive language and exuded the "presence of voice in the text" (Eisner, 1991: p. 36). Using the natural setting as the source of data, the researcher managed to observe, describe and interpret settings as they were, maintaining what Patton calls an "empathic neutrality" (1990: p.55). The researcher acted as the "human instrument" of data collection, because she had to pay attention to the idiosyncratic as well as the pervasive, seeking the uniqueness of each respondent.

Through this methodology, an emergent (as opposed to the predetermined) design was imposed, and the researcher had to focus on the emerging process as well as the outcomes of the research questions. In addition to field notes, the researcher used photographs and audio tapes as a means of accurately capturing the setting. A summary of the focus group interview questions was provided in Chapter 4, Analysis and Findings.

According to several anthropologists (Geertz, 1973; Sieber, 1973; Rist, 1977), the use of in depth interviews as done in focus groups, also functioned as the glue that cemented the interpretation of the multi-method results. It could potentially generate what could be called "holistic work" or "thick description." As Wolcott (1994: 344-345) concluded, "qualitative data secured from in depth interviews was apt to be superior to quantitative data in density of information, vividness, and clarity of meaning". The reports generated through the in depth interviews were typically rich in detail and provided insights into participants' experiences of the world and "may be epistemologically in harmony with the reader's experience" (Jick, 1979, p.5).

However, this methodology does come with its disadvantages, such as the extensive amount of time needed to conduct the interviews and the possibility of interviewer effects which included interviewee social response bias (Judd et al., 1991). Both of these were given due diligence by the researcher while conducting the depth interviews.

3.3.2 Research Flow Process : 2007

In 2007, an attempt was made to do a follow-through research study on the two granaries, MADA and KADA. The objective was to identify any development in the levels of KAP among

the agricultural extension officers as well as to record any change in the six key variables in both the rice granaries. Hence a second round of research processes were put in place. A diagrammatic description is made of the second round of research process flow conducted over the time period of 2007. This is depicted in Figure 3.2 below. In addition, a table detailing the underlying research objectives of each research activity together with the personnel involved during this time period is displayed in Table 3.2 below.

Figure 3.2 : Research Flow Diagram : 2007

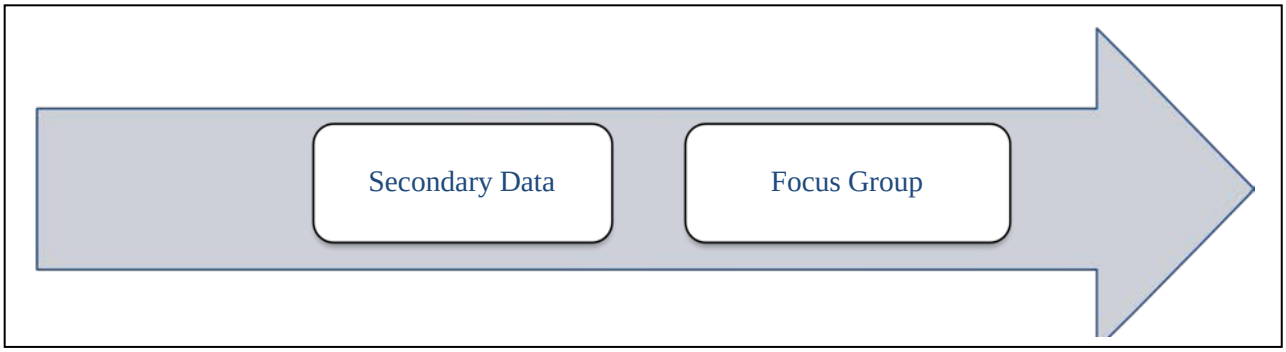


Table 3.2 : Research Flow Description : 2007

Research Activity Description	Research Objectives	Personnel Involved
Secondary Data Annual Reports of MADA	• To secure an understanding on the performance and IPM activities of MADA + some Performance Indicators	
Secondary Data Annual Reports of KADA	• To secure an understanding on the performance and IPM activities of KADA + some Performance Indicators	
Focus Group interviews	• To secure an understanding	• 2 Heads of Departments

conducted with Heads of Departments in MADA	on the current IPM practices adopted in MADA with respect to the six key variables or critical success factors	
Focus Group interviews conducted with Heads of Departments in KADA	• To secure an understanding on the current IPM practices adopted in KADA with respect to the six key variables or critical success factors	• 2 Heads of Departments

- Secondary Data

An analysis was conducted on the Annual Reports of MADA and KADA, with the objective of securing an understanding on the current IPM practices adopted in the rice industry in Malaysia. The Annual Reports from MADA and KADA provided information on the performance of each granary as well as highlighted the multiple IPM activities undertaken by the respective granary to promote the adoption of new IPM innovation and technology.

- Focus Group Interviews

To secure an update on the current IPM practices adopted in MADA and KADA with respect to the six key variables or critical success factors, two Heads of Department from MADA and two Heads of Department from KADA were interviewed. The main objective of this exercise was to extract from them the latest developments on the six key variables of this research and to record any improvements. The same open-ended questions were utilised so as to provide a frame of reference for comparisons to be made by the researcher.

3.4 Research Questions

The research questions were designed to identify whether the six key factors as identified in the literature review, helped to facilitate or impede the successful implementation of IPM technology and innovation, in the two largest rice granaries in Malaysia. To determine this, the Heads of Department were interviewed through a focus group interview. The researcher analysed the responses received by doing a comparative analysis between both the granaries. From the researcher's evaluation, conclusions were drawn as to the degree of facilitation or impediment the six key factors had on each respective rice granary.

An extensive review of the literature indicated that the presence of the six key factors facilitated the successful implementation of IPM technology and innovation. Conversely, the absence of these key factors would lead to the hindrance of the IPM technology and innovation being diffused successfully. The six key factors were;

1. top management
2. structure and culture

3. social system
4. communication system
5. intermediaries' role and
6. innovation attributes

From the literature review, all these six key factors played an integral role in influencing the agricultural extension officers' level of KAP. This was because the presence of the six key factors would create an environment where the KAP of the agricultural extension officers would be greatly facilitated. Conversely, the absence of these six key factors would have an adverse effect on the KAP level of the agricultural extension officers as these officers would not feel encouraged to improve themselves in such a deficient environment.

Additionally, when the KAP level of the agricultural extension officers was strong, the likelihood of successful IPM innovation diffusion was endorsed, and the reverse is to be held true. Hence research questions were designed to explore all these ramifications. The following questions were created and they were targeted at the Heads of Department at the two rice granaries. The questions were;

1. Whether 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, who were the front-liners to the end-users, namely the rice farmers.

2. Whether the structure and culture in their respective organisations supported the agricultural extension officers' process of acquiring and understanding the new IPM innovation so as to promote their level of KAP.

3. Whether the social system comprising the various inter-related organisations needed for the complete support of the diffusion procedure of IPM innovation, helped to boost the KAP of the agricultural extension officers such that they increased their momentum on the diffusion process of IPM to the rice farmers.

4. Whether the communication system within their respective granaries was sufficiently aggressive to amplify the KAP of the agricultural extension officers such that they were able to deploy the IPM diffusion process well to the rice farmers.

5. Whether the role of the intermediaries' (the change agents and the early adopters or farmer leaders) was enhanced such that they accelerated and facilitated the IPM innovation implementation process.

6. Whether the attributes of the innovation assisted in improving the process of facilitating the smooth diffusion process of IPM to the farmers.

3.5 Research Instrument

The research instrument designed for this study was a questionnaire, which acted as the data collection tool. The written questionnaire was a useful method for the collection of self-reported data. The questionnaire, being an impersonal written instrument, carried both the instructions and questions for the respondents, and provided space for the researcher to complete their answers (Emory, 1980). This had been the dominant mode of measurement in the behavioural

sciences and was most appropriately used when the perceptions of individual respondents were of primary interest (Babbie, 1992).

The questionnaire contained qualitative elements only. The goals of the qualitative element were to do the following; capture the frame of reference, provide a definition of the situation of the given respondent, avoid instrumentation artefacts of standardized measurement procedures, permit detailed examination of the processes and elucidate the factors peculiar in this research to allow greater understanding of causality.

Questionnaires had the advantage of reducing interviewer bias and of being relatively inexpensive. However, some disadvantages were; the questionable data quality related to non-response bias, accuracy and completeness of data collected (Judd, Smith, & Kidder, 1991). Furthermore, the usage of questionnaires may on its own render insufficient as it more often than not, required additional corroborative evidence to be collected through observations so as to make sense of the data reflected in the questionnaires (Whyte, 1984).

According to Miles & Huberman (1994), interview questions which upheld the flexible nature of qualitative research, should be modified over time so as to allow the researcher to focus attention on areas of particular importance and to exclude questions which the researcher found to be unproductive in comparison to the research problem. Through this process the researcher managed to ask probing questions to get in-depth information that helped improve the accuracy, completeness and meaningfulness of the data collected, in this research study. This methodology also helped to identify problem areas and provided possible interpretations for data collected by other methods as well. The above mentioned activities facilitated the researcher in making better

estimates of the respondents' attitudes and beliefs towards the successful implementation of IPM, being the dependent variable of this study (Kerlinger 1986).

The questionnaire contained three main sections;

- Part I: Six Key Variables of top management support, structure and culture, social system, communication system, intermediaries' role and innovation attributes
- Part II: Demographic Details of the Respondents
- Part III: Influencing Variables of Knowledge, Attitude and Practice

A sample of the questionnaire can be found in Appendix 1.

Part I: Six Key Variables section

The objective of this part was to identify the presence of the six key variables in the two rice granaries in Malaysia. Briefly, a summary of the questions were as follows;

Question 1: Top Management

An attempt was made to investigate the level of top management commitment towards the implementation of IPM innovation diffusion. An open-ended question was created to record this key variable. Various aspects were investigated, such as; whether 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, as they were the front-liners to the end-users, namely the rice farmers.

Question 2: Structure and Culture

An attempt was made to determine the extent to which the organisational structure and culture in the agricultural extension officers' respective organisations supported their tasks of acquiring and understanding the new IPM innovation knowledge so as to promote their level of KAP. With a strong KAP, it was assumed that this would help to promote the success of the diffusion of IPM innovations. An open-ended question was created to measure this key variable.

Question 3: Social System

An attempt was made to determine whether the social system, comprising the various inter-related organisations needed for the complete support of the IPM innovation diffusion, helped to boost the KAP of the agricultural extension officers such that they increased their momentum on the diffusion process of IPM to the farmers. An open-ended question was designed to attain a thorough view needed to record this key variable.

Question 4: Communication System

An attempt was made to determine whether the communication system within their respective granaries, coupled with the communication with the external IPM related organisations, was sufficiently aggressive to amplify the KAP of the agricultural extension officers such that they were able to deploy the IPM diffusion process well, to the farmers. To get a deeper view of the trappings of this variable, an open-ended question was produced to confirm the presence of this key variable.

Question 5: Intermediaries' Role

An attempt was made to determine whether the role of the intermediaries' (the change agents and the early adopters or farmer leaders) aided to enhance and accelerate the KAP of the agricultural extension officers. This consequently should aid in the facilitation of the IPM innovation implementation process. To secure sincere responses, an open-ended question was formed to gauge this key variable.

Question 6: Innovation Attributes

An attempt was made to identify whether the attributes of the innovation assisted in improving the KAP of the agricultural extension officers in such a way that it facilitated the process of smooth diffusion of IPM to the farmers. To solicit an in-depth view of this variable, an open-ended question was generated to determine this key variable.

Part II: Demographic Details of the Respondents

In this section, demographic and general background details of each respondent were trapped in the close-ended questions. The constructs explored were; respondents' age, education level, name of organisation and also their tenure of working.

Part III: Influencing Variables of Knowledge, Attitude and Practice

The open-ended questions in this section were directed to the agricultural extension officers from both MADA and KADA. The questions were divided into three sections, namely;

Section 1: Knowledge of IPM

Section 2: Attitudes towards IPM

Section 3: Practices of IPM adopted

The objective of this section was to assess the strength of the KAP of the agricultural extension officers between the two largest rice granaries in Malaysia. Festinger (1954) discovered that

where the respondents' beliefs, perceptions and attitudes were being measured, the questions should be designed to tap these dimensions. Hence the questions were arranged from general to specific or using the funnel approach. This arrangement of questions helped the respondents through the items which facilitated smooth and easy progress.

A description of the rationale behind the questions generated under each of the Sections 1, 2 and 3 were given below;

SECTION 1: Knowledge of IPM

An attempt was made to measure the level of knowledge of the agricultural extension officers towards the characteristics of an IPM farmer and also the characteristics of a non-IPM farmer. This would be a quick acid-test done on the agricultural extension officers to facilitate an assessment on their strength or level of knowledge of IPM. Open-ended questions were phrased to determine whether they knew what, why and how an IPM farmer would behave when he uses the IPM technology and innovation.

Their responses would be indicative of their level of knowledge of IPM innovation adoption or diffusion. Additionally, these agricultural extension officers were questioned as to some of the characteristics of a non-IPM farmer. The responses from the agricultural extension officers would be indicative of their level of knowledge of prudent IPM practices and also non-compliance of IPM practices.

Through this methodology, the true level of 'knowledge' possessed by the agricultural extension officers with respect to the IPM diffusion process could be identified. Close-ended alternatives were not presented to the respondents as it was feared that the research would fail in elucidating the true level of knowledge as the respondents may be tempted or become biased towards the fixed alternatives offered, without ever revealing the truth.

Section 2: Attitudes towards IPM

An attempt was made through 'dual-response' questions at assessing the agricultural extension officers' attitude towards the IPM process. A total of 10 questions were phrased with the assistance of a panel of world rice experts, to elucidate the agricultural extension officers' attitude towards IPM. All the questions contained both positive and negative aspects to test the consistency of responses and to reduce biasness. Using the "Yes" or "No" response, all the items had a set of fixed options to which the respondents expressed agreement or disagreement.

Section 3: Practices of IPM adopted

In this section, a set of 10 questions were presented in a similar format as Section 2 above, viz., through the 'dual-response' format. These questions were directed at assessing the level of knowledge of the agricultural extension officers towards the prudent IPM practices that should be adopted. These 10 questions were also formulated with the aid of a panel of rice experts, to draw out information on whether the recommended IPM practices were adopted and practised by the agricultural extension officers. Using the "Yes" or "No" response, all the items had a set of fixed options to which the respondents expressed agreement or disagreement.

3.6 Data Collection

The research instrument was administered by the researcher by conducting personal interviews with the respondents from the two largest rice granaries in Malaysia. The principal respondents in this exploratory research were the Heads of Department from MADA and KADA as well as the agricultural extension officers from these two granaries. The interviews were conducted with the aid of a standardised set of open-ended and deal-response questions which were repeated with each respondent, as endorsed by Patton (1990). This helped to minimise variation in questions and to reduce the possibility of bias that came from having different interviews with different respondents. Notes were jotted down immediately so as to aid memory and acted as a means of accurately capturing the responses. Additionally, this approach facilitated data analysis as it was possible to locate each respondent's answer to the same question rather quickly.

Generally, qualitative researchers tend to use inductive analysis of data, meaning that the critical themes emerged out of the data (Patton, 1990). Qualitative analysis required some creativity, for the challenge was to place the raw data into logical, meaningful categories to examine them in a holistic fashion and to find a way to communicate this interpretation to others. The goal was to create descriptive, multi-dimensional categories which formed a preliminary framework for analysis. Words, phrases or events that appeared to be similar were grouped into the same category and followed through with the complex process sometimes called "axial coding" (Strauss and Corbin, 1990). The discrete categories identified in open coding were compared and combined in new ways as the researcher began to assemble the "big picture". The purpose of coding was to not only describe but, more importantly, to acquire new understanding of a

phenomenon itself and the ramifications of the phenomenon must be identified and explored. Then the research report would be a rich, tightly woven account that "closely approximated the reality it represented" (Strauss and Corbin, 1990, p.57).

3.6.1. Unit of Analysis

The principal respondents and unit of analysis in the case study and in depth interviews were the agricultural extension officers from MADA and KADA. The principal respondents and unit of analysis in the focus group interviews were the Heads of Department from MADA and KADA. Their demographic and general background information was trapped in Part II of the questionnaire through close-ended questions.

3.6.2. Sampling

The following section gave a description of the selection process for the sample of agricultural extension officers chosen from MADA and KADA for this study. The sample selected represented a cross section of extension officers involved in the implementation of IPM activities in these two granaries. The total population of agricultural extension officers was 170 in MADA and 42 in KADA. The decision about who qualified to be classified as respondents was made by the Heads of Department from MADA and KADA. Their choice of respondent was based on the qualification and experience of the staff, viz., the agricultural extension officers.

The Heads of Departments at MADA and KADA provided the researcher with an updated list of the population of agricultural extension officers. Since each agricultural extension officer had a

known and equal chance of being selected, then purposeful sampling plan had the least bias and offered the most generalisability. Purposeful sampling was used as it was the dominant strategy in qualitative research. Purposeful sampling sought information-rich cases which could be studied in depth (Patton, 1990). The sample selected was not done randomly, rather on purpose because only those who were currently involved or had previous experience in IPM extension activities were selected.

Decision on sample size depended on the degree of accuracy required, the degree of variability in the population, and the kind of data analysis that was planned. Sample size could be estimated statistically. Rules for determining sample sizes were based on past experience with samples drawn from statistical methods, and they were commonly used when studying large populations, according to Neuman (1997). These rules were; a small population needed a large sampling ratio to have an accurate sample. For example, a population of below 1,000 required a sampling ratio of 30% to achieve a high level of accuracy. For large populations of above 150,000, smaller sampling ratios of about 1%, were often sufficient. In general, practical considerations such as cost and logistics were the most important deciding factors.

Deciding how many respondents to include was an important concern in survey research. The whole population at each district were not selected, rather a sample size of 50% were selected. This was because if the whole population was used, the responses would reach a saturation point as the respondents would be repeating their responses. The respondents, notably the agricultural extension officers, played an influential role in the dissemination of IPM innovation to the farmers, who were the end-users. The case study and in-depth interviews were conducted with these selected respondents on an individual basis.

3.7 Data Analysis

After completing the field survey, coding and data processing were conducted. These analysis were done according to the structure of the research tool, viz., the research questionnaire.

Under Part I: Six Key Variables

With respect to this section of the questionnaire, the responses collected were to identify the presence of the six key variables of top management, structure, culture, social system, communication system, role of intermediaries and attributes of innovation. A comparative analysis was conducted between the two rice granaries of MADA and KADA so as to draw some conclusions as to the existence or presence of the key variables. From the comparative analysis, it was determined which of these variables were present in MADA and KADA and hence they were classified as the drivers towards the successful implementation of IPM technology and innovation diffusion. Conversely, it was determined which of these variables were absent in MADA and KADA and hence they were classified as the inhibitors towards the successful implementation of IPM technology and innovation diffusion.

Under Part II : Demographic Details of the Respondents

Under this part of the questionnaire, a description of the demographic details of the respondents was captured. All the data encapsulated was analysed and summarised into the following categories, viz., the age profile, the level of education of the agricultural extension officers and

also the number of years of service they contributed to their career as agricultural extension officers. All the data analysed were done for both rice granaries so as to secure a comparative understanding.

Under Part III : Influencing Variables of Knowledge, Attitude and Practice

- Knowledge

All the responses gathered were to measure the influencing variable of 'Knowledge'. Although the respondents provided responses to open-ended questions, all their responses were given a 'weight' by a panel of experts from the International Rice Research Institute Steering Committee. The weights ranging from '5' to '1' were assigned. These numbers reflected the level of accurateness of the agricultural extension officers responses to the definition or description of the characteristics of an IPM farmer and also the definition or description of the characteristics of a non-IPM farmer. the weight of '5' was awarded to a response that had the highest level of accuracy while the weight of '1' was awarded to a response that had the lowest level of accuracy. Once this was done, the total scores for each response was calculated and presented in percentages for easier comparative analysis tests to be conducted between the two rice granaries of MADA and KADA.

- Attitude

Under this section of the questionnaire all the responses collected regarding the level of 'Attitude' of the agricultural extension officers. A summary of the responses were collated so as to compute an average score.

- Practice

Under this section of the questionnaire all the responses collected regarding the level of 'Practice' of the agricultural extension officers. A summary of the responses were collated so as to compute an average score.

Finally with respect to measuring the successful implementation of IPM innovation in MADA and KADA, some performance indicators were identified from the research. These included the following ;

- major pest attacks
- rice yield per granary
- usage levels for insecticides
- usage of levels for herbicides
- usage of levels for rodenticides.

Comparative analysis between the two rice granaries was conducted to correlate the data with the extent of successful IPM technology and innovation diffusion in their respective rice granaries. A set of secondary data could provide an insight as to the level of success that occurred over a series of years, provided the information was available and dispensed to the researcher.