



## **Aquaculture and Poultry Feed Manufacturing Workshop**



**Report on an Aquaculture and Poultry Feed Manufacturing Workshop held at the Coffee Research Institute, Aiyura, Papua New Guinea 6-8 December 2006**

**Mark Booth, Geoff Allan, Jacob Wani and Helena Heasman**

## SPONSORS AND CONTRIBUTORS

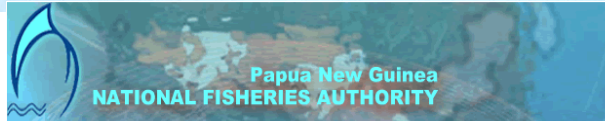


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# WORKSHOP FLIER



*Announcing*

## **FEED MANUFACTURING WORKSHOP - PNG.**

to be held at

**Coffee Research Institute  
Aiyura  
Papua New Guinea**

**6-8 December 2006**

Small scale aquaculture and poultry production in some developing countries is providing an important source of protein to supplement otherwise meager diets. It is therefore important to have an understanding of fish and poultry nutrition and how to produce cost-effective feeds by utilising locally available agricultural products. This workshop will focus on hands-on training in small-scale feed manufacture using newly-commissioned equipment in conjunction with lectures covering the following aspects of grow-out nutrition:

- PRINCIPLES OF AQUACULTURE NUTRITION
- INTRODUCTION TO DIET FORMULATION
- PELLETING & EXTRUSION OF COMMERCIAL FEEDS
- NATURAL FEEDS & INTEGRATED AQUACULTURE
- POTENTIAL FEED INGREDIENTS
- FARM MADE & LABORATORY FEEDS
- FEED MANAGEMENT - STORAGE
- FEEDING STRATEGIES

GUEST LECTURERS INCLUDE:

- \* DR GEOFF ALLAN & DR MARK BOOTH, NSW DEPARTMENT OF PRIMARY INDUSTRIES, AUSTRALIA
- \* DR PHIL GLATZ, SA RESEARCH & DEVELOPMENT INSTITUTE, AUSTRALIA
- \* MR PETER MINIMULU, PNG DEPARTMENT OF AGRICULTURE & LIVESTOCK, GOROKA, PNG
- \* MR GREG DENN & MS HENAO BOURAGA, PROJECT SUPPORT SERVICES LIMITED, LAE, PNG
- \* MS IRENE GUBAG, OK TEDI MINING LIMITED, WP, PNG



**Report on**  
**an Aquaculture and Poultry Feed Manufacturing**  
**Workshop held at the Coffee Research Institute, Aiyura,**  
**Papua New Guinea**  
**6-8 December 2006**

**1. EXECUTIVE SUMMARY**

The Feed Manufacturing Workshop was held at the Coffee Research Institute (CRI), Aiyura, Papua New Guinea (PNG) from 6-8 December 2006 to assist with the production of feeds, based on locally-available ingredients, using simple, relatively inexpensive small-scale feed manufacturing equipment. 41 invited delegates attended. The workshop included both formal lectures and hands-on training. While the focus of the workshop was aquaculture feeds, it became evident during the workshop planning phase that there was also a demand for feeds for other animals, particularly chickens, and that both aquaculture and poultry feeds could be produced using similar, small-scale feed manufacturing equipment. In response, the workshop was expanded to include information on poultry nutrition. Key topics covered during the workshop included principles of aquaculture and poultry nutrition, potential feed ingredients, introduction to diet formulation, principles of feed manufacture, feed management and storage and feeding strategies. The lectures were presented by Drs Geoff Allan, Mark Booth and Phil Glatz, Mr Peter Minimulu, Ms Irene Gubag and Mrs Janet Pandi. Delegates made their own feeds using small-scale feed manufacturing equipment (the lecturers were assisted by Mr Joe Alois and Mr Wally Solata), learnt about practical aspects of feeding fish and were instructed in how to operate the equipment safely and on how to maintain it by Mr Greg Denn from Project Support Services Limited and delegates.

Last year the Australian Centre for International Agricultural Research (ACIAR) entered into a contract with NSW Department of Primary Industries (DPI) entitled *Increasing capacity for regional fish feed manufacture in PNG* which provided funds to purchase the feed manufacturing equipment involved and enable the Principal Investigators, Drs Geoff Allan and Mark Booth, to participate in the Workshop and provide training in aquaculture nutrition and aquafeed formulation using locally grown agricultural ingredients. ACIAR also funds several other inland aquaculture projects in PNG and developing cost-effective feeds and feeding strategies are key R&D priorities within these projects. The aquaculture component of the Feed Manufacturing Workshop was based on material developed and presented during the Aquaculture Nutrition Master Class which was held at the Asian Institute of Technology, Bangkok, from 7-19 August 2006, and funded by the ATSE Crawford Fund together with the Australian Centre for International Agricultural Research (ACIAR). Drs Geoff Allan and Mark Booth from NSW Department of Primary Industries (NSW DPI) were among the 14 international aquaculture nutrition specialists who compiled and delivered lectures at the Master Class. The ATSE

Crawford Fund provided additional funds to the National Fisheries Authority (NFA) to cover travel, accommodation and conference hire for participants to attend the Feed Manufacturing Workshop in PNG. Chickens are another important source of protein in PNG and ACIAR has also funded two projects with the common aims of encouraging farmers to replace expensive commercial feeds with home-grown and manufactured feeds. Dr Phil Glatz from South Australia Research & Development Institute (SARDI) is the Principal Investigator on this project and was also invited to attend the workshop and impart his poultry nutrition expertise.

Coordination and administration of workshop activities in PNG was carried out by NFA's officer, Mr Jacob Wani; pre-workshop planning and coordination in Australia was carried out by Drs Geoff Allan and Mark Booth assisted by Mrs Helena Heasman.



## **2. INTRODUCTION**

Aquaculture is a small but rapidly developing industry in the coastal and highland regions of PNG. Development of this industry has the potential to provide an important supplemental source of protein in the diets of Papuans as well as provide an opportunity to derive income. Development of aquaculture in PNG is being assisted by agencies such as the NFA, the National Department of Agriculture & Livestock (NDAL) and Eastern Highlands Province through their Highlands Aquaculture Development Centre (HAQDEC) at Aiyura. ACIAR is now assisting in the development of aquaculture in PNG and has formed collaborative partnerships with these key agencies. Assistance is provided through funding for infrastructure, development and research and targeted training programs.

## **3. NEED FOR WORKSHOP**

The lack of locally available low-cost feeds and suitable feed making equipment to produce them has been identified as one of the major constraints limiting the development of small scale aquaculture in PNG. At the same time, the availability and cost of commercially manufactured feeds makes their use prohibitive. The supply and nutrient composition of local feed ingredients which are suitable for use in simple aqua-feeds is also extremely variable. Ingredient choice is also problematic, because while PNG farmers have access to many ingredients (mostly by-products), many of them are of low quality in terms of protein content, especially for aquaculture species such as trout and barramundi that require relatively high protein diets for rapid growth. The majority of small scale farm holders also lack the basic nutritional knowledge necessary to formulate practical, nutritionally adequate diets from locally available ingredients. Many also lack the necessary skills and experience to make high quality farm-made feeds suitable for feeding fish. The infra-structure necessary to produce and store dried feeds and ingredients is also lacking.

The nutritional knowledge and practical skills of small scale farm holders must be improved in order to ensure that PNG can take advantage of the benefits of aquaculture. An increase in this knowledge base will also directly benefit other agricultural industries reliant on the feeding of stock such as the rapidly expanding poultry industry. These needs have been addressed in a three day Feed Manufacturing Workshop funded by the Australian Centre for International Agricultural Research (ACIAR). The workshop consisted of a series of nutritional seminars and practicals that were based on modifications of lecture material presented at the ATSE Crawford Fund Aquaculture Nutrition Master Class held in Bangkok in September 2006.

## **4. WORKSHOP GENERAL**

The workshop was conducted at the CRI, Aiyura, PNG, between Wednesday 6th and Friday 8th December 2006 (see agenda – Appendix 10.1). The CRI is located in the Eastern Highlands Province of PNG, approximately 100 km drive south of Goroka. Approximately 40 participants attended the workshop including small scale farm-holders, provincial and government representatives as well as students (see list of participants – Appendix 10.2). The majority of participants were actively involved in either the production of fish or poultry or engaged in the construction of ponds or cages in readiness for stocking.



*Mr Greg Denn (Project Support Services Limited, PSS: seen here to the right of the equipment in the lower right photo) was a special workshop invitee and was responsible for coordinating the purchase and delivery of feed making equipment associated with the ACIAR project. He was enlisted to conduct a feed equipment safety seminar for participants at the workshop using feed making equipment he had brought with him from Lae. During the practical sessions Mr Denn also presented information on the various types of feed making equipment available in PNG using a large photo-display board.*



Other participants from key agencies were instrumental in setting up some of the practical aspects of the workshop. This included the strategic placement of posters, display of juvenile fish in aquaria, organisation of vehicles and accommodation and the preparation of ingredients and feed making facilities at HAQDEC.

As far as possible, hand-outs and other workshop materials were prepared and shipped in advance from NSW DPI Port Fisheries Centre (PSFC). NSW DPI also provided two computers and an electronic projector for use at the workshop. A suitable screen was achieved by hanging a white table cloth on the wall. All participants and lecturers were accommodated in facilities located at or close to the CRI centre and morning tea, lunch and light refreshments were provided each day.



Each participant was presented with a workshop folder containing introductory material and printed versions of all power-point presentations. In addition each participant was given a CD containing PDF copies of all presentations, PDF copies of the National Research Council's *Nutrient Requirements of Fish* (NRC 1993) and an FAO publication titled *The Nutrition & Feeding of Farmed Fish & Shrimp* (Ed. Albert G.J. Tacon 1987). Participants were also provided with a hard-copy of a draft ACIAR publication titled *Preparing Farm Made Fish Feed in Fiji & Papua New Guinea* as well as literature on the nutritional requirements of poultry which was provided by Dr Phil Glatz. Miscellaneous folder items included an extensive list of potential feed ingredients for use in fish and poultry diets and a simple pro-forma for conducting small scale feeding experiments. In total, these resources provided each participant with an extensive amount of introductory level material on fish and poultry nutrition. All participants expressed a high level of satisfaction with the workshop materials and many commented on their usefulness during the workshop and acknowledged they would be an invaluable reference.



*Workshop participants. See Appendix 10.2 for full list.*

## 5. WORKSHOP - FOCUS

The workshop focused on several key areas of small scale aquaculture in PNG. The *nutritional requirements and feeding of fish*, the *assessment and selection of feed ingredients*, the *principles of formulating and manufacturing simple farm made feeds* and the *appropriate storage of feed ingredients and diets*. In terms of lecture content, the majority of information related to nutrition and feeding strategies for fish. These lectures were presented by Dr's Geoff Allan and Mark Booth. Dr Phil Glatz (SARDI) presented several excellent seminars on the digestive system and nutritional requirements of layer and broiler chickens. The material on fish and poultry was entirely complimentary in terms of presentation and content. Dr Glatz's presentations were extremely well received by the participants and precipitated considerable discussion. Apart from the more theoretical seminars, several smaller presentations were given by Peter Minimulu (NDAL), Irene Gubag (Ok Tedi) and Janet Pandi (National Agricultural Research Institute; NARI).

The workshop commenced with Dr Geoff Allan (NSW DPI) and Mr Jacob Wani (NFA) welcoming all the participants (see Appendix 10.2 for full list). Each participant, including lecturers, was then asked to formally introduce themselves and their affiliation. The group was then introduced to the workshop materials and advised of the workshop agenda (see Appendix 10.1). A formal welcome and opening of the workshop was made a short time later by the District Administrator of the Eastern Highlands Province. Participants were encouraged to ask questions and interrupt presentations to raise points of interest during seminars as well as at the end of each scheduled session. Two dedicated practical sessions were held during the workshop. The first involved a presentation on equipment safety and operation (Greg Denn) and the second a feed making and feeding session (see below). A dedicated discussion session (wrap-up) was held at the conclusion of the workshop (Friday) and all participants were offered the opportunity to speak directly to the forum in an informal manner. The workshop was formally closed by Dr Allan, Mr Jacob Wani (NFA) and Mr Bubia Muhuzu (EHP) who thanked all participants for their attendance and encouraged all present to use their new found skills to expand the sustainable growth of aquaculture in PNG. The workshop concluded with the presentation of certificates (see Appendix 10.3), a group photograph in front of the CRI conference room (see photograph on previous page) and lunch.

Several seminars presented during the workshop by Drs Allan and Booth focused on feed and ingredient storage. These lectures presented information on the ideal methods of storage for feeds and feed ingredients, but recognised that for many small scale farmers in PNG the ideal is unachievable. As small-scale farmers move towards making more farm made feed and drying pellets, these issues will become more and more significant and undoubtedly cause many problems. Electrical supply and continuity is problematic in many places and access to cool-rooms non-existent. *The storage and transport of larger volumes of feed and feed ingredients under the high temperature, high humidity conditions experienced throughout much of PNG may be the single biggest issue facing PNG farmers as they scale up their aquaculture or poultry enterprises.*

The need for several feed ingredients with a higher protein content and quality was also acknowledged, especially for farmer's wishing to formulate feeds for carnivorous species such as

trout and barramundi. Access to a suite of suitable feed ingredients is also limited for many farmers making it more difficult to formulate feeds that satisfy the nutrient requirements of fast growing fish because ingredient flexibility is reduced. At present the fishmeal that farmer's are sourcing from Lae has relatively low protein content and is of variable quality due to its high inclusion of frames (high ash). There is some potential of a rendering plant sourcing herring from the Fly River Estuary (Irene Gubag – Ok Tedi) which may provide a fishmeal with higher nutrient specifications.

## 6. PRACTICAL FEED MAKING AND REVIEW OF HAND-MADE FEEDS

A major aim of this workshop was to couple the theoretical information of lecture material to the practical aspects of formulating, making and storing farm made feeds. Unfortunately the equipment ordered for the workshop did not arrive due to factors beyond the control of the organisers. Hand operated equipment was used in its place with most of the feed making equipment and feed ingredients transported from the NDAL centre at Goroka to HAQDEC.

In order that all participants gained as much practical feed making experience as possible, they were broken into four smaller groups and assigned a different task. Group 1 and 2 were assigned a formulation exercise that required them to weigh, mix, pellet and dry 1 kg of a formulated tilapia diet. Group 3 were assigned a feeding assessment task with brood-stock tilapia and Group 4 was given the opportunity to review and discuss feed making equipment and machinery. The groups were rotated to a new exercise after the completion of each task. Dr Mark Booth (NSW DPI) and Mr Peter Minimulu (NDAL) led the feed making exercise. Dr Geoff Allan (NSW DPI) and Mr Wally Solata (ACIAR Project) led the feeding exercise and Mr Greg Denn conducted the feed equipment review. In addition to these exercises, Mr Peter Minimulu conducted an informal presentation on the design, construction and operation of a solar drier. This presentation was given in the newly built solar drier at HAQDEC which was constructed using funds provided by ACIAR for the feeds workshop (~K8000).



*Making extruded feeds*

Each of the groups enjoyed making their feeds and each group successfully produced pellets which could be fed to fish. These feeds were labeled and placed in the newly built solar dryer for review the following day. Wet samples of each feed were also taken, stored in airtight containers and refrigerated. As expected, there was some variation in the quality of pellets produced by each group, mostly due to moisture content. These differences provided a useful basis for contrasting the quality of each feed the following day.

Wet and semi-dry feeds were brought up from the HAQDEC to the CRI conference room for review. All feeds were displayed on feeding trays and samples of wet and dry feed were also immersed in water to study pellet water stability. Participants were asked to review the feeds and discuss differences between each group. This session promoted a lot of discussion an interest and was led by Drs Allan and Booth. Group discussion included use of starchy binders to increase feed and water stability, use of more powerful pellet making equipment and changes to formulations that can increase or decrease the bulk density of feeds.



## 7. WRAP-UP SESSION (OPEN FORUM)

The workshop was concluded with a “wrap-up” session involving all participants and presenters. Topics of discussion included the problems associated with trying to calculate the cost-benefit analysis of using regular and novel ingredients in aqua or poultry feeds because of the huge variation in the quantity and quality of regional and provincial supplies. An agreement was reached that some assumptions will need to be made but heavily qualified!

Some participants saw that the use of local / regional or vernacular names for certain feed ingredients could become confusing. This is particularly important in publications that present typical formulations for tilapia, trout and barramundi feeds etc.

The balance between production of carp and tilapia was considered. There is now a greater demand by consumers for tilapia than carp in many regions. In Yonki, 400g tilapia can reach K10-15 each, which is almost double the price of chicken. In Lae, tilapia are commonly sold for approximately K8-8.50 per kilogram. Demand for tilapia is particularly high from the Asian sector (Johnney Soranzie, pers. comm.).

During the workshop several participants expressed an interest in presenting their work on aquaculture or poultry feeds research and aquaculture development in different regions of PNG. These requests were also accommodated in the “wrap-up” session. These unplanned presentations stimulated further group discussion among all participants and gave individuals the opportunity to express their views on the potential benefits and problems facing small-scale aquaculture development in PNG. A brief summary of each presentation follows:

- *Dr Miok Komolong (University of Technology – Lae, PNG)*

Dr Komolong presented details of a fish nutrition and poultry feed experiment undertaken by students he was supervising at the University of Technology (Department of Agriculture) in Lae. Both students were participating in the workshop. The first presentation was titled *Evaluation of local protein and energy sources for GIFT Tilapia Farming in Papua New Guinea* (Densley Tapat) and the second was titled *Evaluation of two Leucaena leafmeals and copra meal as substitute feeds for broiler chicken finisher diets* (Eric Nogas). Dr Komolong stated that the Unitech facility has limited resources in terms of experimental systems for studying fish growth and nutrition but is currently building capacity in this area. At the conclusion of his presentation Dr Komolong offered the use of the experimental and analytical services of his department to participants of the workshop. He suggested that collaborative trials would benefit the growth of aquaculture in PNG.

- *Jonah Bobogi (Wanowari Tilapia Cage Culture Project, Sirinumu)*

Mr Bobogi gave a very interesting oral presentation about the development of his reservoir based, tilapia farm located 20 minutes from Port Moresby. He had also gone to the trouble of preparing a number of A4 size photographs which he used to describe the facilities at Sirinumu. During his presentation he thanked Jacob Wani and Peter Graham. Mr Bobogi covered topics including the

preparation of earthen broodstock ponds, construction of floating pontoons and cages and the grow-out potential of his enterprise. He believes the floating pontoon structure at his farm may be the 1<sup>st</sup> of its kind in PNG! At the inception of his operation he had many problems with fingerlings, but now seems to have overcome many of these issues. He believes production of his own fingerlings on-farm will alleviate further problems with supply and quality of tilapia fingerlings. He also expressed an interest in growing barramundi. He was feeding his tilapia with farm made “dough ball” feeds but is now also feeding pellets. This year his operation was able to produce 0.5 to 1kg tilapia which were extremely well accepted by the local market. Demand outstripped supply in this instance.

- *Michael Kaugam (ChildFund Australia)*

Mr Kaugam gave an overview of the project work Child Fund Australia is doing in Boroka. He detailed the efforts of his team in developing village infrastructure such as a 3mtr high dam and in ground ponds and tanks for finfish farms. The objective of Child Fund in these enterprises is to provide livestock and food for subsistence living and improve health by reducing the incidence of malnutrition etc. At this stage the majority of construction is complete and they are waiting for the rains to fill their dams, ponds and tanks so they can be stocked with fish.

- *Matthew Ten (Maria Kwin Centre, Sisters of Notre Dame)*

Mr Ten gave an extremely animated talk entirely in Pidgin. His presentation was punctuated with several moments of humour that were appreciated (by those who could understand him!). He discussed the number of farmers growing common carp in his region, how he had become an extension officer, doctor, farm manger and much more since his involvement in aquaculture. Matthew stated that there are 3000-4000 fish farmers in the highlands keen to get access to fingerlings and feeds. He is also Vice-President of the Poultry Growers Association in the Mt Hagan area. He acknowledged the help of several people including Sister Pauline, Jacob Wani and Peter Minimulu.



*Matthew Ten*

## **8. FIELD TRIP TO YONKI DAM**

Geoff Allan, Mark Booth, Jacob Wani and Wally Solata traveled to the Yonki Dam Research Station at the conclusion of the feeds workshop to inspect a tilapia feeding experiment (i.e. approximately 1 hour by road from the CRI) (ACIAR Mini-Project led by Cathy Hair). Several other workshop participants that were traveling back to Lae also took the opportunity to visit the Station (e.g. Greg Denn, Klaus & Tom Neumeier, Miok Komolong, Densly Tapat, Eric Nogas, Johnney Soranzie & others). The Yonki Dam was created to drive a hydro-electric power scheme providing electricity to much of PNG. The Research Station is located close to the water and fenced in sections. It consisted of two major structures (manager's residence and office / laboratory) as well as several small in ground ponds, some fibreglass tanks and an out-building for storage. Several boats were moored along the shoreline.

The whole group was transferred by boat to a floating pontoon located approximately 100m from the bank. The structure was anchored in water about 25-30 m deep. This was the second such platform constructed at Yonki Dam; the first had been vandalised and sunk. The new structure was floated using large sections of sealed PVC piping lashed with wire and rope. Timber slats were fixed on the top to create a walking platform. Experiment cages were about 1m<sup>3</sup> and were framed at the top with bamboo and secured to the sides of the pontoons at various locations. The experiment was testing the effects of stocking density and diet type on the performance of juvenile tilapia. Each treatment was replicated 4 times (16 cages). Two densities were being studied; low density (15 fish per cage) and high density (200 fish per cage). Diets were the established feed available to cage farmers in Yonki that is a mix of chicken grower pellets and fish meal (roughly 85:15) or a specific tilapia pellet made at NDAL, Goroka, using a formulation devised by Peter Minimulu and Geoff Allan. Fish were supposed to be fed to apparent satiation twice a day and weighed each month. Individuals from the visiting group were given the opportunity to feed the fish their respective diets. Wally Solata conducted a dissolved oxygen test and an attempt was made to upload information from a data logger.

There was some thought that the rigour of this study may have been compromised by inconsistent feeding and a lack of attention to the cages. The top mesh of each cage is small and some pellets do not pass into the cage. The satiation feeding regime may also have been compromised at times during the experiment. There is enormous potential for cage culture in Yonki Dam and given its location, the Station has a huge potential in terms of aquaculture research.

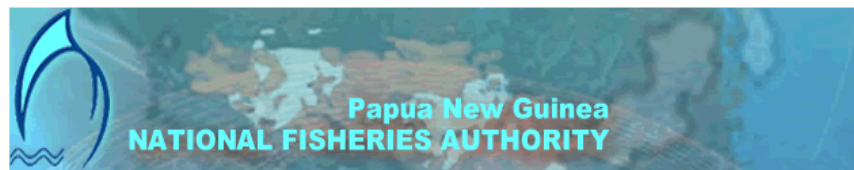
## **9. GOROKA – EQUIPMENT REVIEW AND STORAGE AT NDAL**

Dr's Allan and Booth spent approximately ¾ day with Jacob Wani, Peter Minimulu and Joe Alois at NDAL Goroka. While there they conducted a review of the feed making equipment and feed and ingredient storage areas. Several recommendations were made on simple, low cost but effective ways to improve each of these areas. Joe Alois was also tutored in the use of the WinFeed formulation package by Dr Booth.



## **10. APPENDICES**

- 10.1 Workshop program
- 10.2 List of participants
- 10.3 Certification of completion



# FEED MANUFACTURING WORKSHOP - PNG.

Coffee Research Institute, Aiyura  
6-8 December 2006

## WORKSHOP AGENDA

### DAY 1: Wednesday 6<sup>th</sup> December

08:30	Introduction and welcome	Jacob Wani/Geoff Allan
09:00	Nutrients – description and function	Geoff Allan/Mark Booth
10:00	Discussion	
10:30	Break	
11:00	Nutritional requirements of fish	Geoff Allan/Mark Booth
12:00	Nutritional requirements of poultry	Phil Glatz
13:00	Lunch	
14:00	Feed ingredients – Introduction	Mark Booth/Geoff Allan
14:30	Feed ingredients in PNG - fish	Peter Minimulu (results of survey, etc)
15:00	Potential fish meal from Fly River Herring	Irene Gubag
15:30	Feed ingredients in PNG – poultry	Phil Glatz/Janet Pandi
15:45	Break	
16:15	Practical session 1 – Making Feeds. Setting up and operating equipment safely	Greg Denn/Henao Bouraga/Peter Minimulu/Mark Booth
17:30	Close	

### DAY 2: Thursday 7<sup>th</sup> December

09:00	Introduction to feed formulation	Mark Booth/Geoff Allan
10:00	Feed Manufacturing	Peter Minimulu/Mark Booth
10:30	Recap and discussion	
11:00	Break	
11:30	Commercial feeds	Geoff Allan/Mark Booth
12:00	Feed storage and management	Mark Booth
13:00	Lunch	
14:00	Practical session 2 – mixing ingredients and making pellets	Peter Minimulu/Irene Gubag/Mark Booth
15:30	Break	
16:00	Prac. session 3 – making feeds & drying	Peter Minimulu/Mark Booth
17:30	Close	

### DAY 3: Friday 8<sup>th</sup> December

09:00	Review of feeds – pellet stability and Discussion/practical on how to improve pellets etc.	Led by Mark Booth/Peter Minimulu
10:30	Break	
11:00	Feeding strategies	Geoff Allan
11:30	Sampling, analysis & exp. Protocols	Geoff Allan/Mark Booth/ Irene Gubag
12:00	Recap and discussion	Geoff Allan/Mark Booth/Phil Glatz
13:00	Presentation of certificates/workshop close	
13:30	Official lunch	

## 10.2 Workshop Participants

Name	Institution	Phone	Fax	Email
Allan Quartermain	Chief Scientist, National Agriculture Research Institute, PO Box 4415, Lae, Morobe Province	4751444	475 1450	<a href="mailto:alan.quartermain@nari.org.pg">alan.quartermain@nari.org.pg</a>
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Bubia Muhuju	Advisor, Division of Primary Industry, Department of Eastern Highlands, PO Box 766, Goroka, EHP	7322263	732 3600	<a href="mailto:bmuhuju@yahoo.com.au">bmuhuju@yahoo.com.au</a>
Charlie Availe	Chairman, Eastern Highlands Fish Farmers Association, c/NDAL, PO Box 1075, Goroka, EHP		732 3600	
Densely Tapat	University of Technology, Dept. of Agriculture, PMB, Lae, Morobe Province	473 4451	4734452	
Dr. Miok Komolong	University of Technology, Dept. of Agriculture, PMB, Lae, Morobe Province	473 4451 /6857584/	4734452	<a href="mailto:mkomolong@ag.unitech.ac.pg">mkomolong@ag.unitech.ac.pg</a>
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Johna Bobogi	Sirinumu Cage Culture Project,	3230799		
Johnny Soranzie	Senior Aquaculture officer, DAL Erap, PO Box 1984, Lae, MP	474 9333	474 9301	<a href="mailto:northdal@global.net.pg">northdal@global.net.pg</a>
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### 10.3 Certificate of Participation

