PILOT PHASE RICE PRODUCTION IN MARKHAM VALLEY OF PAPUA NEW GUINEA SHOWS GREAT PROMISE

R. Chris Dekuku[1]

ABSTRACT

Agriculture in the Markham Valley is dominated by moderate intensity of banana cultivation and taro and peanuts in the Upper Markham. Rice was not a crop in the farming systems until 1997, when the FAO/PNG Special Program in Support of Food Security and collaborating partners DAL-Erap Rice and Grain Program, DPI Mutzing Extension Services and R.O.C Taiwan Technical Mission and the Farmers introduced rice to the Villages of Naratumua, Ragiampun, Intoap and Minimian. In introducing the rice to the area, the Team was aware of the constraints of the Rice and Grain Industry as discussed in this volume and took that into consideration in the design and implementation of Pilot Phase Rice Program in the Markham Valley. They also took into account the Initial Farming Systems Analysis in Two Pilot Districts in The Markham Valley, that was done at the start of the Special Program in Support of Food Security in the area in 1996..

The result was that, first time rice farmers in the Markham Valley produced rice under rainfed conditions and obtained yields equal to or better than rice yields in dominant rice producing countries. The result indicated that rice production shows promise in the Markham Valley. Farmers from Naratumua, Ragiampun, Intoap and Minimian have embraced the rice technology and are initially producing and milling rice for home consumption, and saving money for not having to buy rice.

Keywords: *Drilled, Dibbled, Broadcast, Rainfed rice, 14% moisture, Adjustment coefficient, Gross margin, Value addition.*

INTRODUCTION

A Pilot Phase of A Special Program for Food Security [SPFS] was implemented in the Markham Valley in Papua New Guinea [PNG] from 1996 to 2000 as part of a global approach towards food security being sponsored by the Food and Agricultural Organization of the United Nations [FAO] and respective National Governments. This is because PNG is one of the 83 Countries classified as of Low Income and Food Deficit. FAO and Papua New Guinea therefore decided to initiate the SPFS in order to begin addressing the food security needs initially on a Pilot Phase in the Markham Valley of PNG

Markham Valley was selected because of its relatively good infrastructure; road net work, access to market in Lae and even Port Moresby and the Highlands, availability of a range of farming systems, relatively good moisture availability, availability of technical and scientific departments and staff [Department of Agriculture and Livestock, Department of Primary Industry, University of Technology, Fresh Produce Development Corporation, Republic of China on Taiwan Technical Mission and recently the National Agricultural Research Institute] to guide and provide support to the program design, implementation as well as monitoring and evaluation, availability of agro-industries, as well as the possibility of expansion of the Program as a result of land availability [Prodoc 1996].The Program aimed at rapid approach to food security; initially, on a limited scale, and for the success and lessons gained/learnt to be used, to stimulate investment on a wider scale for the extension and expansion of the Program to other parts of PNG.

The vast flatlands of the Markham Valley are usually referred to in political circles as the potential 'bread basket of PNG'. Thus it was logical for the reasons above, to initiate the SPFP in the Markham Valley.

In order to improve on the capacity of the members implementing the program a group training workshop in Farming Systems Development [FSD]; inclusive of Participatory and Rapid Rural Appraisal was conducted from August 11 to September 6, 1996 and documented, published and widely distributed [Bammann *et al* 1996]. Mem-

[1] Agricultural Information Branch, Department of Agriculture & Livestock, P.O. Box 417, **Konedobu**, National Capital District, Papua New Guinea

bers of the Program Implementation Groups and farmers from the targeted villages in the Huon and Kaiapit Districts of the Program sites were involved right from the constraints analysis stage at the start and they contributed significantly to the program implementation processes.

The SPFS Program had four components, **Constraints Analysis** of the farming systems, **Intensification** of the production systems using improved technologies, **Diversification** of the production systems using new crops and integration of small livestock and **Water control** or small irrigation development and management

The introduction of rice into the area fell within the intensification, diversification and water control components.

MATERIALS AND METHODS

In 1996, the National Grain and Rice Program in Collaboration with the SPFS and the International Rice Research Institute and Trukai Industries provided two month long Rice Farming Systems training at Lae and Erap to 42 Rice Extension Officers from the 19 Provinces of PNG. This was to upgrade extension staff expertise on rice. This included six extension/technical staff in the Markham Valley Program area.

At the start of the in 1996, SPFS in the Markham Valley, the Extension staff and Technical Officers from Erap and Markham Valley were trained and participated in the Farming Systems Analysis in six representative villages. One hundred and twenty farmers also participated. This farming systems analysis gave an additional insight into the farming systems and the constraints faced by the communities. The interaction with the farmers over the period created a better understanding and bond between the farmers and the Program Implementation Groups.

Since rice is a new crop to the farmers, farmers were trained at the Village level; using two earlier established farms. Training followed the operational and growth stage of the rice crop. Village level training allowed many farmers and the children to attend and practice prior to implementing the technologies on their plots.

Farmers were trained to:

1. Plough once and harrow their plots twice at weekly intervals before planting. No ploughing or harrowing down the slope. The weekly intervals allowed for better weed control, than when all operations are done in the same week.

2. Plant or seed their rice directly in lines through drilling in furrows 30 cm apart, or dibble in line into holes 30cm apart or broadcast seeding at 80kg/ha basis. Plot sizes were approximately 0.2 ha for individual farmers and 0.5-1ha for group farmers.

3. Sow and grow rice earlier within the rainy season so as to capture enough moisture and also to avoid drought that normally sets in about May.

4. Apply basal fertilizer, NPK at the rate of 50, 50 50 [kg/ha] of N, P_2O_5 and K_2O respectively, at the last harrowing time so as to have the fertilizer well incorporated into the soil and not left on the surface to be evaporated or washed and eroded out of the plot.

5. Weed on schedule, twice at 3-4th week and 7-8th week respectively.

6. Top-dress the plots [50kg N/ha] soon after the second weeding

7. How to identify maturity stage of rice and to harvest on time so as to avoid too dry of cracked grains that would mill poorly.

8. Taught on how to rouge out off types of rice so as to obtain uniform crop, pure seed and grain, and to save the seed for their next crop

9. How to harvest using the sickle as well as small motorized harvesters.

10. Thresh the harvested rice manually or using the motorized threshers

11. Dry the grain and how not to under or over dry, as that would affect the quality of Milling.

The Program trained the Village Leaders in the running, care, maintenance and management of rice mills.

The farmers on learning each of these operations on the two earlier established farms went to practice them on their own within the same or next few week. Thus they have the knowledge fresh on their minds.

The Farmer Leaders who were trained earlier in addition to the DPI-Mutzing Extension Staff provided the first stop extension advice to the other farmers on daily or twice weekly basis. The Technical team from DAL- Erap and ROC Taiwan provided weekly extension back up.

Clean seed of the recommended rice variety, Taichung Sen 10 with acceptable cooking and

eating quality close to the commercial 'Trukai' rice [Amoa *et al*] was provided to the farmers by the DAL-Erap and Taiwain Teams.

Since farmers lacked money because of the 1997 drought which depleted their savings, tractor services, seed and fertilizers were given on credit to the farmers, who subsequently paid for them in kind [by seed] at harvest time. The seed were subsequently extended to other farmers in the area.

Farmers provided their own labor for planting, weeding, fertilizer application, harvesting, threshing and drying. However, this labor was estimated in Kina terms and used in calculating the returns.

Initial training and plantings took place as follows; at Naratumua, in the months of December 1997 to January 1998. At Ragiampun in July/August 1998 under irrigated and rainfed conditions. At Minimian in December 1998, and at Intoap in December 99 to January 2000.

The Rainfed farmers were advised not to plant beyond end of January, so as to avoid cessation of the rains about May that may affect crop growth and yields.

Whole plots instead of sampled plots were harvested, so as to avoid any over or under estimation as normally results from plot sampling. Whole plots were harvested also to show and give the farmers the actual yield of their plots.

After harvest, followed by threshing, cleaning and drying, grains were packed into bags and weighed. At the time of each weighing the moisture contents of the grains were also taken. All weight recorded were later adjusted to a constant moisture content of 14% H_2O and the final weight adjusted to kg per hectare basis. This takes care of variation in moisture and therefore weights between farmers / samples that may give rise to non uniform or standard weight comparison.

Moisture and weight standardization follow after [Gomez 1972], as follows;.

To get the adjustment coefficient factor for each sample to 14% H_2O, we use the formula
$A = [100 - M / 86]$

Where A = Adjustment Coefficient and M is moisture level

And to convert your weight to 14% H_2O, we used

$W = A \times W1$

Where W = Weight at 14 H_2O, W1= the initial weight at moisture level M and A is the adjustment factor.

Thus grains with initial moisture content of 14% would have adjustment factor [A] of 1.0, and would therefore retain the same weight; W = W1. Grains with moisture content over 14 H_2O, would have adjustment factor A < 1.0, and would have the final weight lower; W < W1. While grains with moisture level lower than 14% H_2O would have A > 1 and therefore higher weights; W > W1.

RESULTS

The 1997 drought had serious effect on the farmers in the Markham Valley. This is because their traditional cash crop is peanut, which they grow, harvest and market at least three times a year. In 1997, because of the poor rainfall and drought caused by El Nino as depicted by the rainfall at Erap [Fig. 1], very few farmers could grow or harvest peanuts after May, and this affected their income levels.

As happened in most area in PNG, including the Makham, farmers were among those that received food aid. And that aid came mostly in the form of rice. In addition to the fact that rice could also be stored over long periods compared to the traditional roots, tuber and vegetables convinced the Markham farmers to accept the rice pilot program

Naratumua

At Naratumua, we investigated simultaneously, the methods of rice planting and overall yield of rice on farmers plots. Harvest samples were taken from six farmers selected randomly from the 51 that participated for evaluation of planting methods, namely; broadcast seeding, drilling and dibbling.

The results indicated that broadcast seeding performed slightly poorly than dribbling and drilling [Fig. 2]. In an interview that followed later, most farmers prefer the dibbling method, which is the same method they are used to in planting peanuts. They view planting of rice the same as their customary peanut, thus the dibbling method of planting rice was easily adopted.

Whole plot rice yields from 50 farmers gave yields on per hectare basis from 1,298 kg/ha to 11,697kg/ha. Majority or highest frequency [76%] of the farmers had yields in the 2,000kg/ha to 5,000 kg/ha range while only 8% had yields in the 1,000kg/ha to 2,000 kg/ha range. And 22% of the farmers had yields above 5,000 kg/ha [Table 2 and Fig. 3]. The actual yield from 10.56 ha was

Fig. 1. Some Aspects of Erap Long Term and 1997 Rainfall

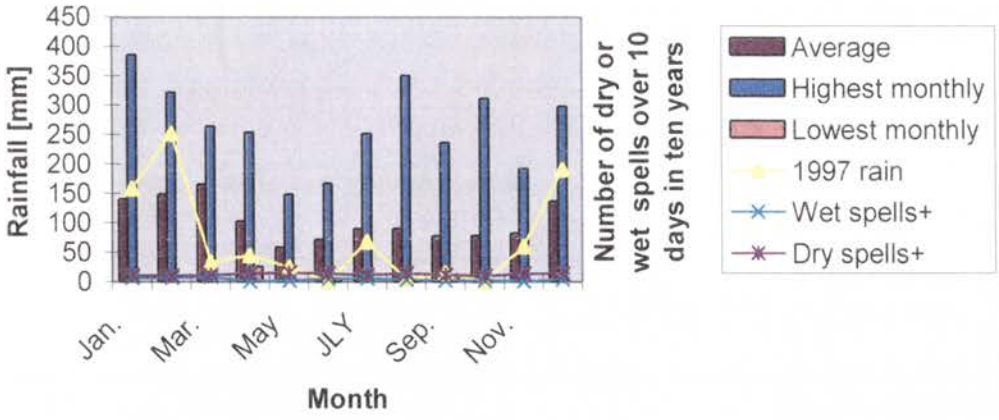


Table 2. Rice planting methods, Naratumua, 1998. Yield and Expected Revenue

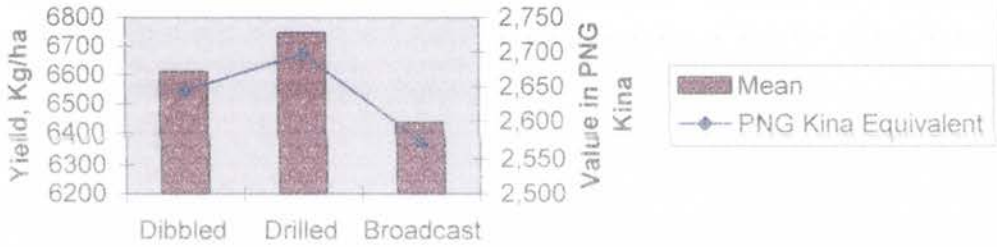
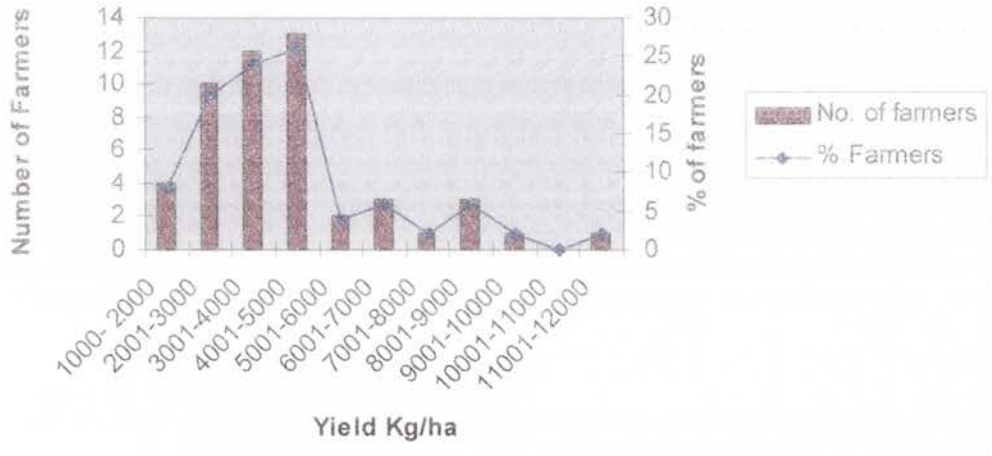


Fig. 3. Naratumua Rice yields kg/ha in 1998



41,838.7 kg/ha at 14% moisture basis, with gave an average yield of 3,960 kg/ha [3.96 tons/ha]. These yields are very high and significant, especially for first time rice farmers.

Gross Margin analysis
Gross margin analysis was done for each of 51 farmers based on;

[a]. Total production cost was calculated, based on; land preparation, seed, fertilizer costs and application, estimated costs for weeding, harvest and post harvest operations

[b]. Income was calculated at the equivalent paddy [un-milled rice] price of K400/ ton.

[c]. Profit or net income was calculated as Income less production costs.

Percent Gross Margin was calculated as Profit divided by production costs and multiplied by 100%.

Gross margin % = { [b] – [a] }x 100% **or** { [c] / [a]} x 100%

Gross margin % = { [b] – [a] }x 100% **or** { [c] / [a]} x 100%

The percent Gross Margin analysis indicated [Fig.4] that eight or 16% of the farmers had negative gross margins. Fifteen or 29% of the farmers had gross margins within 1-100%. Twenty or 39% had gross margins of 101 - 200%, six or 12% had gross margins of 201-300%, while 2% had gross margin of 301-400%. Thus overall 84% had positive gross margins. The lower gross margins were due mostly to lateness in applying cultural operations, such as weeding and fertilization by the farmers, while the higher gross margins were due mostly to timely applications of cultural practices

Intoap

During the 1999/2000 crop season, fifty seven farmers from Intoap participated in growing rice using the dibbled method. All other operations were similar to what was described above for Naratumua.

Grain yields ranged from 0.3 to 6.36 tons/ha at 14% H_2O basis [Fig. 5] with a mean of 2.01 tons/ha. Only nineteen percent of farmers had yields below 1ton/ha, While 33% had yields of 1to 2 tons/ha. All others, that is 48% had yields above 2 tons/ha.

The lower rice yields at Intoap compared to Naratumua were due to a 4 –week drought at Intoap in April-May 2000 (personal knowledge).

Ragiampun and Minimian

In Ragiampun and Minimiam farmers collectively cultivate as a group one or two farms at a time. This group farms also gave good yields as indicated in Fig. 6.

Overall rice production in Markham Valley in 1998 to 2000

Fig. 6 gave the overall mean rice yields in Markham valley based on 128 farms at 3060 kg/ha [3.06 tons /ha]. Mean yields per location were in all cases above 2 tons/ha, which is very significant, because mean rice yields in the World's highest rice exporting country, Thailand is only 2 tons/ha [FAO Statistics 1990 – 2000]

Rice Milling

In 1998, thirty tons of paddy rice from Naratumua was carted to DAL-Erap. Part of it was for the refund of costs of inputs supplied to the farmers by the SPFS. The other quantity was purchased from the farmers at the cost of K400/Kg of paddy rice. This was to give the farmers some cash to continue with their lives after the severe 1997 drought, which resulted into lack of income for many of the households due to failures of their traditional income generating peanut crop.In 1999, the SPFS/ROC Taiwan installed one Rice Mill at Mutzing to assist the farmers mill rice for home consumption. The Milling data [Table 2] indicated that acceptable milling recovery from this first time rice growers. Milling recovery ranged from 43 to 74%, with a mean of 59%. The lower milling recovery of May to July 2000 was due to some farmers eagerness to mill and sampled their own rice soon after harvesting and without properly drying them. Milling recovery improves as the grains got dried. Farmers stock paddy rice and mill as and when they need rice for food, and by so doing save money from not buying rice and that money saved or used on other household needs.

Value Addition to rice through processing

By milling rice instead of selling the paddy [table 2], farmers have value added to their produce, as indicated below;

[A]. The maximum paddy rice value to be gained from selling the 14,180 kg of paddy rice at K0.4/kg = K5,672.

[B]. But by milling, even at 59% recovery, the retail gate value for the milled or recovered 8,400 kg x K2.0/kg = K16,800

Fig. 4. Naratumua rice production, percent gross margins

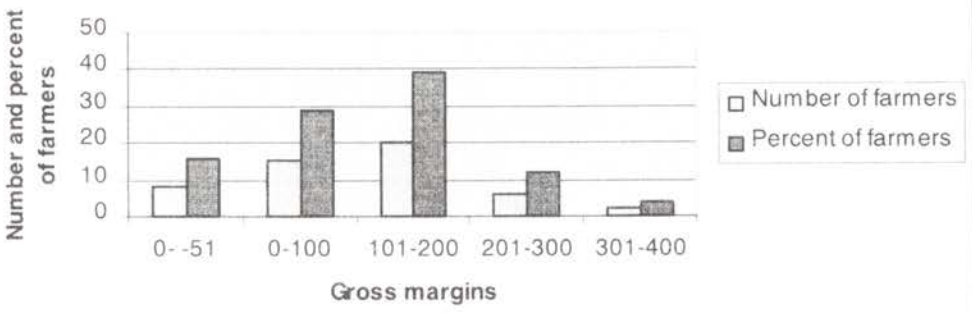


Table 5. Intoap 1999 /2000 Rice Production information [on Kg/ha basis]

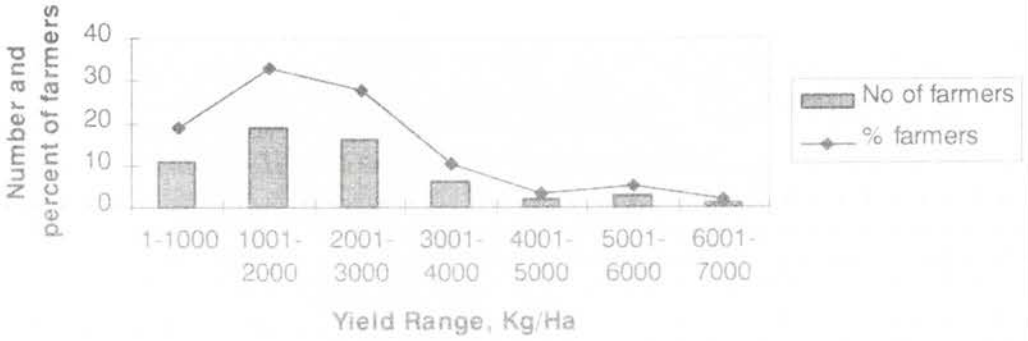
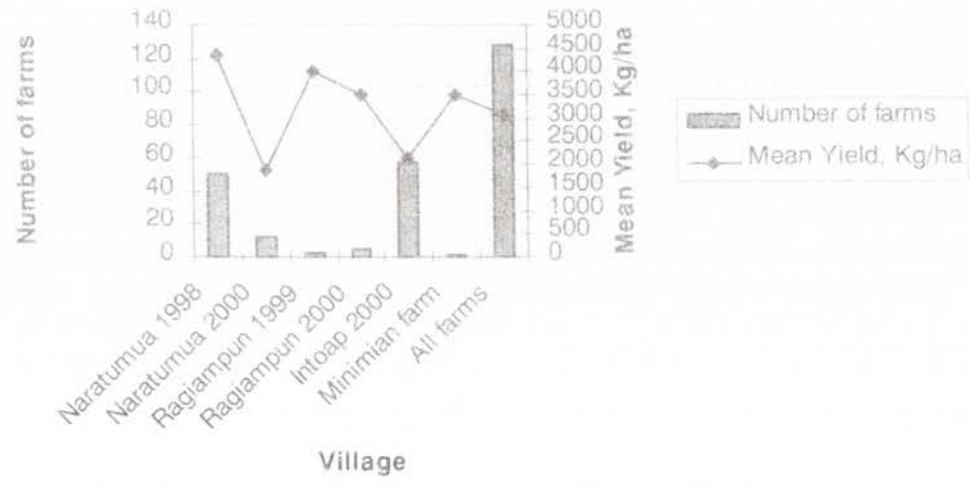


Fig. 6. Mean Rice Yields in Markham Valley, 1998 to 2000



[C]. By taking off the milling cost [K0.2 per kg x 14,180] of K2836 the Net Milled Rice value is K13,964.

[D]. In addition, 5,663 kg of rice bran [a good livestock feed] has been generated at an estimated value of K566.3 or [K0.1/ kg x 5,663]

[E]. The Total Value of rice and bran = K13,964 + K566.3 =K14,530.3

The percent value addition to paddy through milling = {[E – A] / A}x 100%

Value Addition % = {[K14530.3 – K5672] / K5672}x 100% = 156%

Where A = Paddy price value
E = Milled rice + Bran value

Thus by Milling instead of selling rice as paddy we generate % Value Addition of 156%. This in money value for the above milling data = K8858.3 extra over the paddy value of K5672.

Thus, by milling rice, the farmers saved K14,530, which could be used to meet other household needs.

In order to promote not only rice production, but also milling and possible future packaging in production areas, the SPFS has since donated 4 rice mills to the area, and the mills are cited at Erap, Intoap, Chivasing and Naratumua in the Markham Valley.

DISCUSSIONS

Our results, based on data from 128 farms within the period 1998 to 2000; indicated that, even without irrigation, average yield of 2.000 - 3000 kg/ha could be obtained, and yield equivalents above 5 tons/ha are common This is very high for rainfed rices world wide, which indicated a high quality of adaptation/adoption of the optimum production process by the Markham Farmers.

Dibbled and drilled rice were preferred and gave higher yields as compared to broadcast seeded rice.

Gross margins indicated that small scale rainfed rice production is economical with highest gross margin of 300-400%.

By milling rice instead of selling paddy, the farmers or the community would gain value addition through processing. In the above case value addition of 156% was obtained at even a relatively moderate milling recovery of 59%. The Value addition would increase further as farmers gain experience in their production, post harvest management and processing.

The results of rice production in the Markham Valley indicated that small grower rice production could be sustainable.

By using information from the Constraints analysis of the rice and grain industry the Team and the farmers were able to address issues of lack

Naratumua farmers celebrating their bumper rice harvest.

Table 1. **Naratumua rice yields in 1998 on plot and ha basis**

No	NAME	Rice Area, m^2	Yield 14% H_2O, Kg/plot	Calculated Yield, Kg/ha
1	Aisaia Jonah	1716	222.8	1298
2	Simion Yagi	1440	241	1674
3	Ruben Erias	1344	249.6	1857
4	Wilson Abel Ken	880	175.7	1997
5	Lawrence James	3300	694.4	2104
6	Giame Binuai	1716	364.8	2126
7	Yaing Tamat*	5434	1199.1	2207
8	Tani Mura	2394	552.1	2306
9	Max John	8724	2034.5	2332
10	Francis Giame	1716	427.5	2491
11	David Jonah	1716	430.2	2505
12	Fangkis Muri	3024	794.8	2628
13	Eric Amu	2063	559.5	2712
14	Yaru Banabas	3300	950.1	2879
15	Saif Bing	957	299.5	3130
16	Brown Pania	2698	894.2	3314
17	Boni Yamin Afa	1572	529.7	3370
18	Anu Murur	2142	740.3	3456
19	Tom Ufi	3000	1055.1	3517
20	Martha Kais	1890	670.4	3547
21	Simion Yana	2268	807.2	3559
22	Tirimail Buni	1786	653.7	3660
23	Ketumbing G. Ufi	2684	995	3707
24	Gidisa Y	588	229.7	3906
25	Andrew Yaking	2331	929.5	3988
26	Kikingai Pumu	1998	792.6	3997
27	Daniel Yawing	1625	659.2	4057
28	William Balob	2520	1072.3	4132
29	Caspar Y. Gurunts	1512	657	4345
30	Giam Nanu	1984	874.1	4406
31	Teddy Yaku	2470	1129.4	4571
32	Henry Nabri	1302	598.5	4597
33	Maino Steven	2295	1065.9	4644
34	Yaku Ufi	3564	1685.2	4728
35	Sammy S. Mathew	1360	651.6	4791
36	Steven Yaing	1380	661.4	4793
37	Steven Philip	2232	1071.4	4800
38	Simion Afa	1210	596.2	4927
39	Warabum Mura	2140	1056.6	4973
40	Sinur Simon	1520	841.9	5539
41	Maik Yaing	2142	1216.6	5680
42	Giring Yaramu	2460	1479.3	6013
43	Utunan Yana	1808	1096.2	6063
44	Zakia Pania-Paps	1428	979	6856
45	Judah Marabuman	1440	1039.4	7218
46	Simon Mesa	1159	930.6	8029
47	Sakias Pania	1200	966.6	8055
48	Andrew Yaring	1184	1020.9	8622
49	Anna Max	2106	1915.7	9096
50	Ripus Yana	924	1080.7	11696
Total		105,646	41,838.7	
In hectare & tons		10.56 ha	41.84 tons	
Mean		3960 Kg/ha	or 3.96 tons/ha	

Table 2. **SPFS Assisted Small Scale Farmers Rice Milling Statistics at Mutzing, Markham Valley 1999-2000.**

Period	Number of Farmers	Rice Variety	Weight of rice(kg)		% milling recovery	Bran and Husks
			Rough	Polished		
Sep-1999	25	TSC10	2810	2166	77.1	642
Oct-99	11	TSC10	698	471	67.5	228
Nov-99	17	TSC10	1648	864	52.4	732
Dec-99	7	TSC10	459	256	55.7	203
Feb-2000	10	TSC10	983	553	56.3	430
Mar-00	2	TSC10	202	130	64.4	72
Apr-00	5	TSC10	968	719	74.3	308
May-00	4	TSC10	1741	750	43.1	866
Jun-00	24	TSC10	1396	671	48.1	725
Jul-00	29	TSC10	1241	595	48.0	658
Aug-00	34	TSC10	1304	776	59.6	518
Sep-00	12	TCS 10	459	263	57.2	196
Oct-00	9	TCS 10	271	186	68.6	85
Totals	**189**		**14,180**	**8,400**	**59%**	**5,663**
Price/Kg basis			**K 0.40**	**K 2 . 0**		**K0.1**
Expected Value			**K5,672.0**	**K16,800. 0**		**K566.3**

1. **Mean Milling Recovery = [Milled rice /Total paddy rice]x 100% = 8400/14180 X 100% = 59.2%**
2. **Milling cost is K0.2 /Kg, and price for rice bran is K0.1/kg**

of extension, by training farmer leaders and farmers in rice production technologies. Voluntary mobilization of people with their lands was resulted to, where farmers use their own lands, without any force. Expertise and extension support were available to the farmers all season round, from the Mutzing District, DAL-Erap and ROC Taiwan. This collaboration and team working and pooling of resources resulted in the high productivity achieved at the field level. The Trained Farmer Leaders and other Farmers have become the on site extension providers to the other new farmers in their localities, Thus farmers now rely on their trained Leader unlike before where every one was an 'illiterate in rice cultivation'. Thus rice knowledge is now available at the grass roots level to ensure the long term sustainability.

The provision of processing infrastructure, rice Mill and shed and the training of four staff from each village on the running, management and maintenance of the machinery, and giving the complete management of the Mills to the Village Farmers Group, have further increased the interest of the communities in growing and milling rice for food as and when they need to.

Contrary to other reports [Gibson J. 1992, Hanson L.W. *et al* 2001] that seem to suggest that rice production in PNG could not be viable, this pilot phase study in the Markham Valley in PNG indicated that small scale rice production is promising.

ACKNOWLEDGEMENTS

These collaborating staff are acknowledged for their contribution to the success of the study. They are John Jave, Joachim Pitala and Kado Wugrad of DAL-Erap, Dan Lung Chyau of R.O.C Taiwan Technical Mission, Bubia, Weni Yabi and Dakia Wokio of Mutzing Agricultural Extension Program and the Leaders and Farmers of Naratumua, Intoap, Ragiampun and Minimian.

REFERENCES

AMOA, B., DEKUKU, R.C. and NIGO R.Y (1995). Consumer preference of some rice varieties

grown locally in Papua New Guinea . Papua New Guinea Journal of Agriculture, Forestry and Fisheries.38(1): 46-50

BAMMANN, H., DEKUKU, R.C. and RISIMIRI, J. 1999. Initial Farming Systems in two pilot districts in Markham Valley. DAL Printing, Port Moresby. 122 pp.

DEKUKU, R. C. [2001] Constraints Analysis of the Rice and Grain Industry in Papua New Guinea. Papua New Guinea Journal of Agriculture, Forestry and Fisheries [in press]

GIBSON, J. (1992). Rice Self Sufficiency and the Terms of Trade - why rice is a crop to import. Department of Agriculture and Livestock, Policy Working Paper No 2

GOMEZ, K. A.(1972) Techniques for field experimentation with rice. International Rice Research Institute, Los Banos. 49p

HANSON, L.W, ALLEN, B.J. BOURKE, R.M. and McCARTHY T.J. (2001). Papua New Guinea Rural Development Handbook, Commonwealth of Australia, Brown Prior Anderson, Melbourne, Australia. P13.

PRODOC. 1996. Plan of Operations document.