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Review of the development of the rice industry in Fiji



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by
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Subregional Office for the Pacific Islands
Food and Agriculture Organization of the United Nations
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1. Introduction: Rationale for a review of Fiji rice industry development

Rice is consumed by more than half of the world's population; particularly it is the staple food playing a key role to ensure food and nutrition security in Asia and the Pacific. In Fiji rice has been a major source of food for all the ethnic groups as the per capita consumption volume is as high as 75 kg per year, which increased up to 29 percent over the level in 2000. Further, rice has contributed to the improvement of the livelihood of thousands of farmers and their family members relying on rice as a main source of income. Therefore, in Fiji rice has multi-dimension roles as the foundations of food security, economic growth as well as social and political stability.

Unfortunately, the Fiji rice industry has been increasingly weakened over years as the rice area and production declined while the rice yield growth has been stagnant or marginal. Consequently Fiji, which attained nearly 70 percent of self-sufficiency in rice in 1980s has had to import more than 80 percent of the total rice demanded annually. This is a dilemma because the agro-climatic conditions in Fiji are exceptionally favorable for rice cultivation.

In view of this backdrop, the Government of Fiji has envisaged the state of serious dependence on rice imports would be a challenge to the national food security because the trade volume of rice in the international market is very thin and vulnerable due to unpredictable factors like climate change and natural disasters or price shocks. Lessons were learned in the 2008 rice crisis, which did cause political and social chaos in several countries due to severe shortage of rice supply in the market. After this crisis, the rice importing countries like the Philippines, Indonesia and Malaysia, etc. have put more efforts to strengthen rice production toward reducing rice imports and achieving self-sufficiency in rice. Similarly, the Government of Fiji was highly determined to revitalize its rice industry with the establishment the National Rice Taskforce in September 2004 to steer and coordinate the country's rice revitalization program. Since then the Government has given supportive policies and incentives along with increased investment from public and private sector to promote the rice industry development. However, till to date the impacts of these interventions have not been apparently seen as rice production continuously declined and the dependence on rice imports has not been alleviated.

In views of the above situations, the FAOSAP deputed an international consultant to Fiji from 5-30 September 2016 to review of the progress of the Fiji rice industry and elaborate feasible options for promoting the industry development. Findings and results of the mission are presented in this report.

2. Objectives of the mission and methodology

2.1. Objectives

Under the overall supervision of the FAO Sub-Regional Coordinator for Pacific and the technical guidance of LTO and in collaboration with the SAP Production and Protection Officer and multi-disciplinary team at SAP, and the support of the Fiji Ministry of Agriculture, the international consultant undertook a study mission to:

- Assess current rice production (quantities produced, area cultivated, and number of farmers, yield per acre/hectare);
- Update information on total rice imports (source, quantity and values), exports and re-exports;
- Review key development projects in support of rice productions;
- Assess rice research and extension support service;
- Conduct value chain analysis, rice processing, milling, added value and marketing analysis;
- Compile and review technical information and extension materials on rice production;
- Identify major constraints and issues facing domestic rice production;
- Identify opportunities for development and suggest solutions.

2.2. Methodology of study

To achieve the above objectives, the following approaches were applied in the present study:

- On-site and on-farm studies were conducted at the major rice-growing regions of Fiji, namely the Northern Division and the Central Division and at several institutions involving in rice development. At each site, the survey scope covered infrastructure (particularly irrigation) for rice production, farming conditions, production performance, input provision, rice processing, marketing and Government's policy in rice industry development. The international consultant met and discussed with stakeholders, including farmers, local officers, input providers, processors and extension workers.
- Assessment the situation of the Fiji rice industry, Government's policy and strategy in rice industry development through a review of literature and documents from national and international sources, which is supplemented by personal meetings with high-ranking officers at the Fiji Ministry of Agriculture.
- A rice workshop was organized at the Fiji Ministry of Agriculture with the participation of high-ranking officers involving in the rice development policy and coordination. In the workshop the international consultant presented his findings in the study for obtaining

comments and advice from the participants. The presentation of the international consultant was revised and documented after the workshop.

- The international consultant has submitted a final report to FAOSAP after the study mission completed.

Throughout the study, the international consultant worked closely the national consultant of FAO, Mr. John Matawalu who kindly provided his invaluable support, facilitation and advice.

3. Assessment of rice production situation

3.1. Historical rice production in Fiji

Rice has been grown in Fiji for a little over a century. It is cultivated in Fiji before the arrival in Fiji of Indians in 1879. The Indian laborers on sugar cane plantations expanded rice cultivation for family subsistence. The colonial government in 1930s and 1940s started Fiji's first official rice development programs in response to the low sugar prices and high imports of rice. Since 1960, rice area was expanded to the non-sugar land and the specialized areas to grow rice were formed in Northern, Central and Western Divisions.

After Independence in 1970, there was another drive for self-sufficiency and this led to the establishment of large-scale (by Fijian standards) irrigation schemes for rice first at Lakena (Central Division) and later at Dreketi (Central Division) and Navua (Central Division). In 1970s, a total of 11 irrigation schemes in the Central and Northern Divisions were established. Along with the construction of irrigation schemes, several rice development projects were implemented, including the Northern Rice Development Project under Australian Aid in the North, Agricultural Development Project (ADP) in the Central Division and Improvement of Rice Cultivation Technology Project (IRCTP) under Japanese Aid (JICA) at Koronivia Research Station.

During 1980s the Government continued applying several policy measures to encourage rice production, which led to a steep increase of rice production since mid 1980s and Fiji attained 75percent of self-sufficiency in rice. Peak production was achieved in 1989 and 1989 at around 30 000 tonnes of paddy rice per year. In the late 1980s, the Government changed the policy in rice development by applying deregulation, removal of input subsidies (agro inputs, machine, water etc.), neglected investment for infrastructure maintenance and at the same time facilitation of rice imports. These adverse policies immediately resulted in negative impacts to the rice industry as the rice area and production started declining and simultaneously rice imports increased.

3.2. Trends of rice production in Fiji

The long-term trends in rice production for the period of 1961-2014 based on FAO data are presented in Figure 1 and the trends for the period of 1977-2008 extracted from a government source are presented in Figure 2.

As shown in Figure 1, the trends in rice area and production have changed almost in the same direction, which could be dissected in three distinct periods as follows:

- In the period of 1960s-1980s, rice area and production fluctuated up and down in the range of 7 500-13 000 ha and 14 000-23 000 tonnes, respectively. Highest rice production was seen in the mid 1970s (around 20 000 tonnes) thanks to the impact of irrigation schemes constructed in this period, which facilitated growing two rice crops per year and the implementation of some rice development projects.

- In 1980s to 1991, Fiji achieved a dramatic increase in both area and production in which production exceeded 30 000 tonnes and area reached 13,000 ha. The peak of rice production in this period as 33 000 tonnes that was also the peak in the history of rice production in Fiji so far was attained in 1988-1989. The success of rice production in this period was attributed to the favorable supports of the Government to the rice industry and the impacts of the irrigation schemes invested in 1970s.

- In the period starting from 1991 to the present both rice area and production dropped sharply in the same pattern year after year. It is seen that rice area declined from 11 000 ha in 1991 down to 5 000 ha in 2000 and 2,500 ha in 2014. Likewise, rice production decreased from 29 000 tonnes in 1991 down to 13,000 tonnes in 2000 and 5 000 tonnes in 2014. The bottoms of rice area and production were seen in 2012 to decline down to below 5 000 tonnes and 2 500 ha, respectively. These declines were the consequence of the deregulation applied in the late 1980s in couples with policies which did not support domestic production but gave a favor for rice imports. The same trends in this period are also seen in Figure 2.

In contrast to the trends in rice area and production, the trend in rice yield did not show clear-cut changes due to the low stability in rice yield, which happened when rice production was more vulnerable to natural factors, particularly under rainfed conditions as in the case of Fiji. However, it is noted that the yield level exceeded beyond 2 tonnes/ha from 1985 to attain to 2.5 tonnes/ha or more as 3.0 tonnes/ha in recent years.

In study of long-term data on rice production in Fiji, it is observed there was an abrupt decrease in rice yield (down to 0.6 tonnes/ha) and production (down to 5 000 tonnes) in 1998. However, the reason causing this reduction was not reported elsewhere, but it was likely due to natural disaster resulting in severe crop failure.

The trends of rice production from mid-2000s to the present showed that the Rice Revitalization Program implemented since 2004 has resulted in impacts on yield, although the magnitude was still marginal, but it has not yet reversed or prevented the declining trends in rice area and production.

3.3. Current status of rice production in Fiji

Data on rice area, production and yield in Fiji in the last six years (2010-2015) were present in Table 1 (Data source: Fiji Ministry of Agriculture).

The rice area, production and yield in Fiji in the period of 2010-2015 decreased as compared to those in 2000s. In this period, the rice area fluctuated from 1,803 ha in 2012 to 3,355 ha in 2011, the production varied from 4,658 tonnes in 2012 to 7,914 tonnes in 2011, and the yield fluctuated from 2.00 tonnes/ha in 2015 to 3.19 tonnes/ha in 2013.

In 2015, it is recorded that the rice area increased as compared to the previous years, but in 2010-2015, the lowest yield was recorded in 2015. In fact, the low yield levels, as 2.0-2.5 tonnes/ha in four of six recent years are a matter of concern in the revitalization of Fiji rice industry.

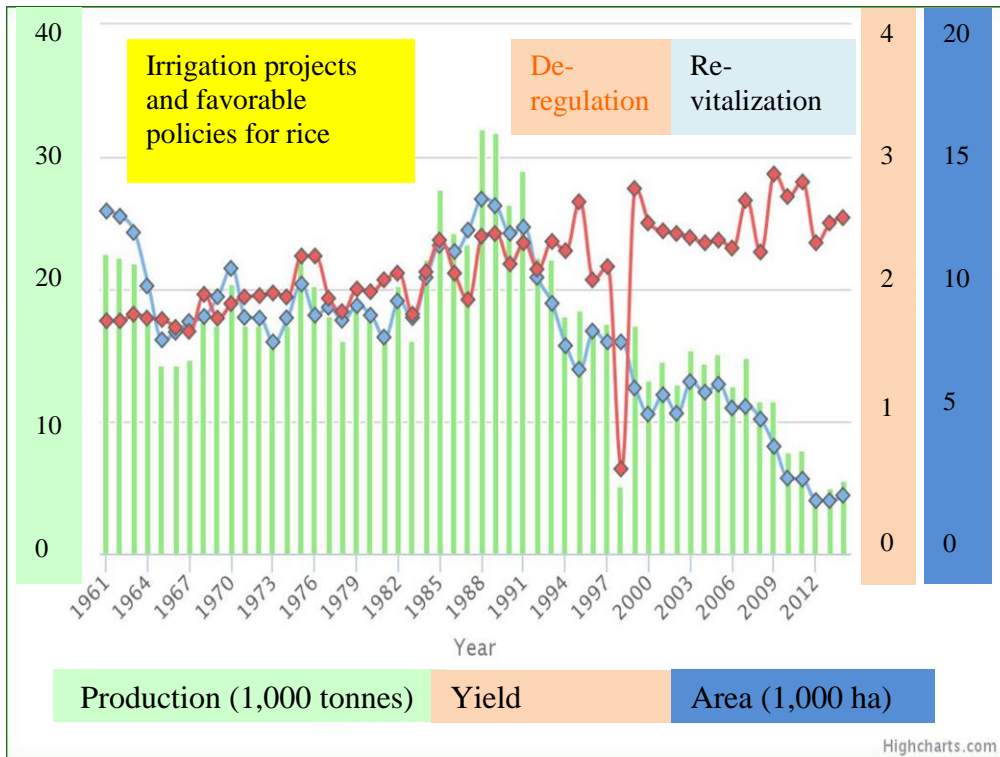


Figure 1. Trends of rice production, area and yield in Fiji during 1961-2014
 Source: Ricepedia (CGIAR/IRRI based on original data of FAO)

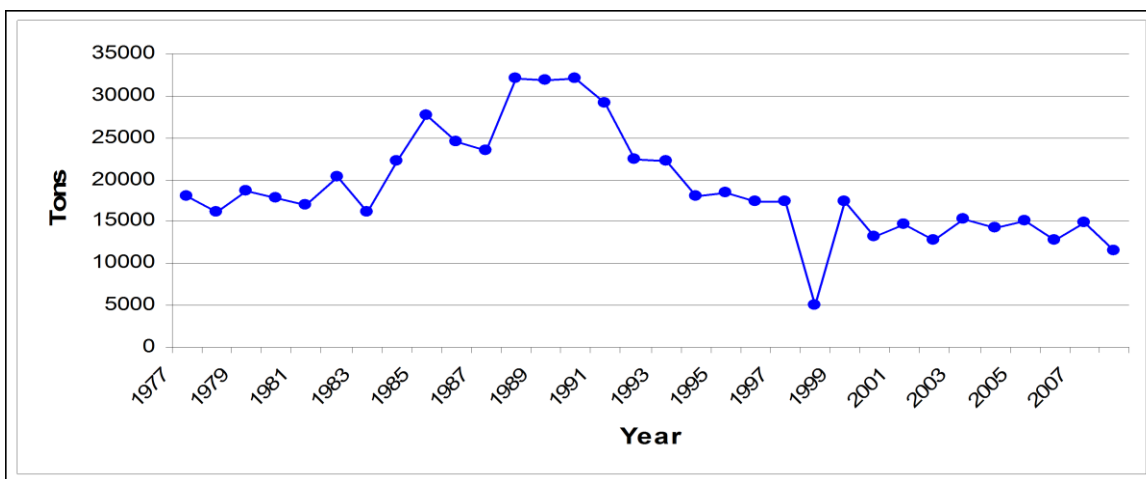


Figure 2. Rice production trend in Fiji during 1977- 2008
 Source: Kamlesh Puran, Fiji Ministry of Agriculture, 2011 based on data source: EP&S MPI (2009)

Table 1. Rice area, production and yield in Fiji during 2010 - 2015

Year	2010	2011	2012	2013	2014	2015
Area (ha)	2 507	3 355	1 803	2 156	3 156	3 200
Production (tonnes)	7 663	7 914	4 653	6 873	6 843	6 329
Yield (tonnes/ha)	3.01	2.36	2.58	3.19	2.20	2.00

Source: Fiji Ministry of Agriculture

4. Rice consumption

Rice and tubers are the staple foods for all the ethnic groups in Fiji. The consumption of rice per capita per year increased from 64 kg in 2000 to 75 kg at present, an increase of 29 percent in 15 years or about 2 percent per year. At the current rate of population growth (0.8 percent) Fiji's rice demand is expected to grow into an additional requirement of 500 to 600 tonnes per year.

The estimation of the contribution of rice to the nutrition of the Fijians as compared to other major foods is presented in Figure 3 and Figure 4 (Ricepedia CGIAR/IRRI). In term of calorie intake per capita per day, rice has contributed about 20 percent (550 kcal/capita/day) and in term of food quantity consumed, rice has contributed about 12 percent (9 gram/capita/day). The contribution to daily energy intake of rice is little lower than that of wheat but higher than meat. These figures showed that rice plays an important in the nutritional demand of the Fijians and it is a source of food rich in energy as it contributes 12 percent of food quantity daily consumed but provides 20 percent of daily energy intake. With the same quality consumed, rice gives 4 times higher in calories than taro.

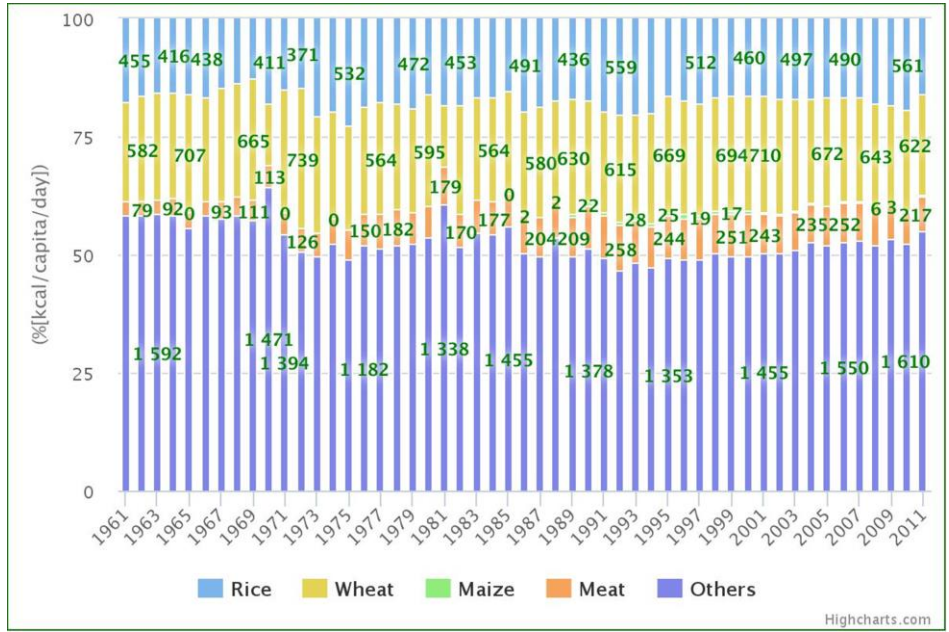


Figure 3. Percentage of kcal/capita/day from rice compared to other food in Fiji
 Source: Ricepedia (CGIAR/IRRI)

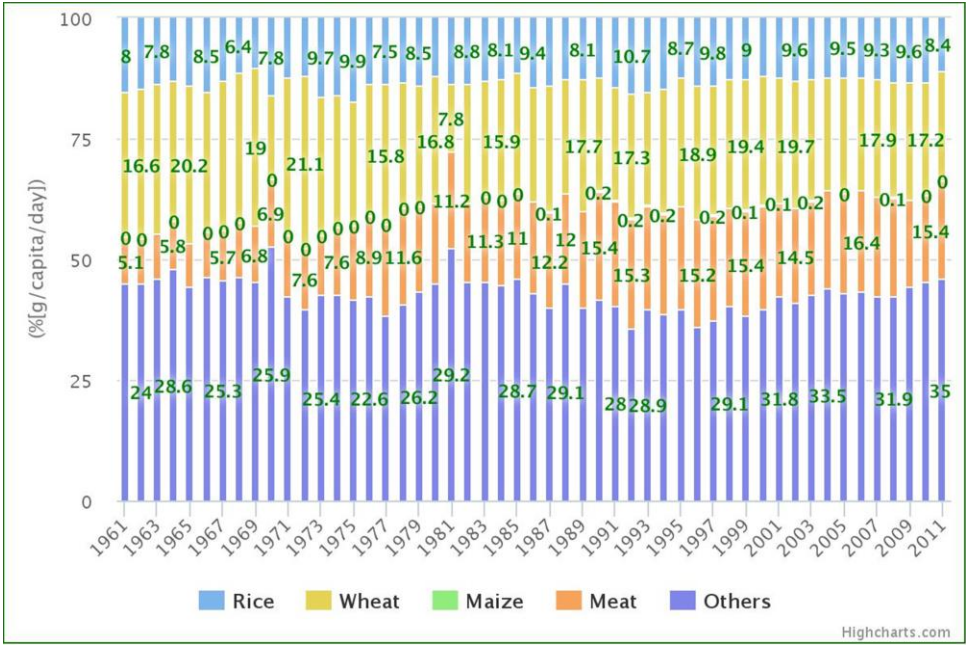


Figure 4. Percentage of gram/capita/day from rice compared to other food in Fiji
 Source: Ricepedia (CGIAR/IRRI)

5. Rice import and export (re-export)

Data on rice imports in terms of quantity of milled rice and import value are presented in Table 2.

During the last six years from 2010 - 2015, quantity of rice imports varied from 25 101 tonnes (lowest) in 2015 to 44 124 tonnes (highest) in 2010. The import value fluctuated from FJ\$ 27.163 million (lowest) in 2015 to FJ\$ 39.385 million (highest) in 2013. The average import price of 1 kg of milled rice ranged from FJ\$ 0.61 (2011) to FJ\$ 1.11 (2012). It is interesting to note that there was a significant reduction of rice imported and import value in 2015 as compared to previous years.

On the average, from 2010 to 2015, Fiji imported 35 060 tonnes of milled rice per year valued FJ\$ 35.709 million per year; and the average price of imported rice was FJ\$ 0.95. The value of rice imports shared a significant proportion in the total import value of agricultural products in Fiji, as it comprised 18.0 percent in total import value of FJ\$ 206.97 million in 2010 and in 16.2 percent in total import value of FJ\$ 223.22 million in 2011.

Domestic production of milled rice (calculated by conversion of paddy to milled rice at a ratio of 65 percent) during 2010 - 2015 varied from 3,024 tonnes (lowest) in 2012 to 5 144 tonnes (highest) in 2011, and on the average it was 4 363 tonnes per year. The total milled rice consumed varied from 29 215 tonnes (lowest) in 2015 to 49 105 tonnes (highest) in 2010. On the average of the last six years, total rice consumed in Fiji was 39 425 tonnes per year.

The level of self-sufficiency from 2010 to 2015 varied from 8.6 percent in 2012 to 14.1 percent in 2015, on the average the level of self-sufficiency was 11.3 percent or Fiji had to import 88.7 percent of the total rice consumed per year.

In the past Fiji achieved self-sufficiency level of 66 percent in 1989, which dropped to 20 percent in 2009.

Apart import of rice, Fiji also exports (re-exports) rice to the Pacific island countries with small quantities varying from 230 tonnes in 2012 to 840 tonnes in 2010 corresponding to a value of FJ\$ 258 and FJ\$ 783, respectively.

A long-term figure of rice imports and exports in Fiji is presented in Figure 5 based on FAO data. It is seen that before 1991 Fiji imported less than 20 000 tonnes of milled rice per year. Rice import started to increase from 1992, which reached a peak of 50 000 tonnes per year in 1997 and 1998, coinciding with a sharp decline in rice production in these years. The long-term trends of rice production and import were presented in Figure 6.

Table 2. Rice imports, total milled rice consumed and self-sufficiency rate in Fiji from 2010 - 2014

Year	2010	2011	2012	2013	2014	2015
Production (tonnes)	7 663	7 914	4 653	6 873	6 843	6 329
Domestic milled rice produced (tonnes)	4 981	5 144	3 024	4 467	4 448	4 113
Milled rice import (tonnes)	44 124	31 651	32 208	38 924	38 355	25 101
Import value (million FJ\$)	37.464	36.189	35.644	39.385	38.406	27.163
Import price (FJ\$/kg)	0.72	0.61	1.11	1.21	1.00	1.08
Total milled rice consumed (tonnes)	49 105	36 795	35 240	43 392	42 804	29 215
Self-sufficiency (%)	10.1	14.0	8.6	10.3	10.4	14.1
Export (tonnes)	840	520	230	800	-	-
Export value (FJ\$)	783	587	258	771	-	-
Export price (FJ\$/kg)	0.93	1.13	1.12	0.96	-	-

Source: Fiji Ministry of Agriculture

Export data from FAO; Domestic mill rice production and level of self-sufficiency estimated by author of this report

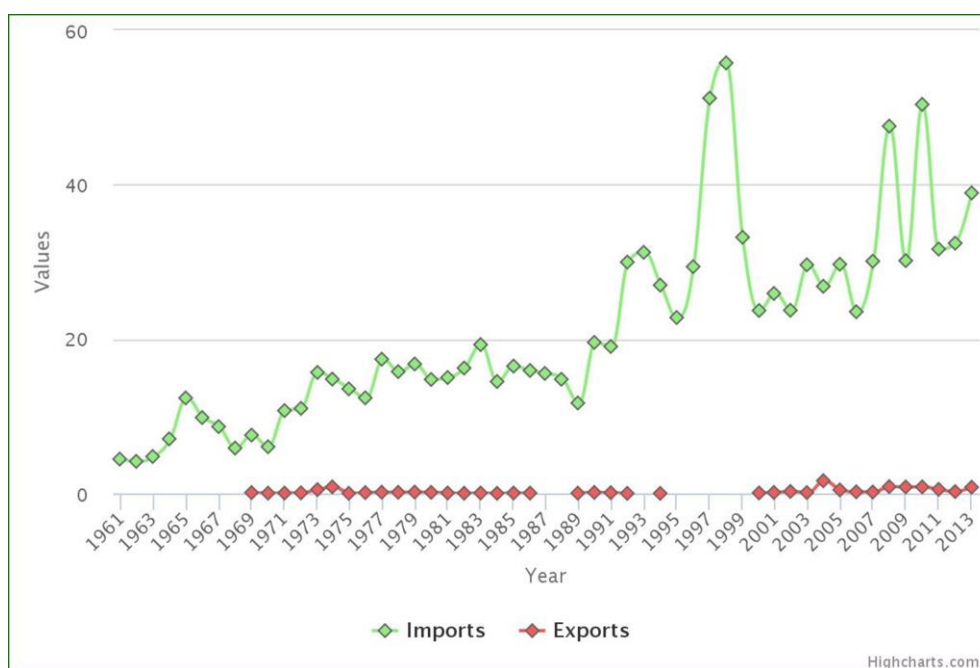


Figure 5. Rice import and export (re-export) in Fiji 1961-2013
Source: Ricepedia (CGIAR/IRRI)

6. Factors affecting rice production in Fiji

6.1. Climate

The climate in Fiji is very favorable for rice cultivation, typically with warm temperature and high rainfall throughout the year distinguished in two seasons, the wet and dry seasons. The wet (rainy) season is from November to April with highest temperature as 32°C and annual rainfall varying from 3 000 mm around the coast to 6 000 mm on the mountainous areas. The dry season is from May to October with the average temperature as 22°C, and the average annual rainfall is 2 000 mm. Total annual sunshine in Fiji is from 1 760 – 2 200 hours with more sunshine in the dry season. Cyclones occurred at a frequency of about 10-12 times per decade. In February 2016, Fiji had the most severe tropical cyclone, namely Winston in recorded history, which caused enormous loss to the country.

6.2. Rice seasons and ecosystems

The two climatic seasons in a year of Fiji intrinsically have formed the two rice seasons, main season and offseason (Figure 6). The main rice season is in the wet season with transplanting in October - November and harvesting in Feb - May. The second rice season or offseason is in the dry season with planting in June - July and harvesting in September - October.

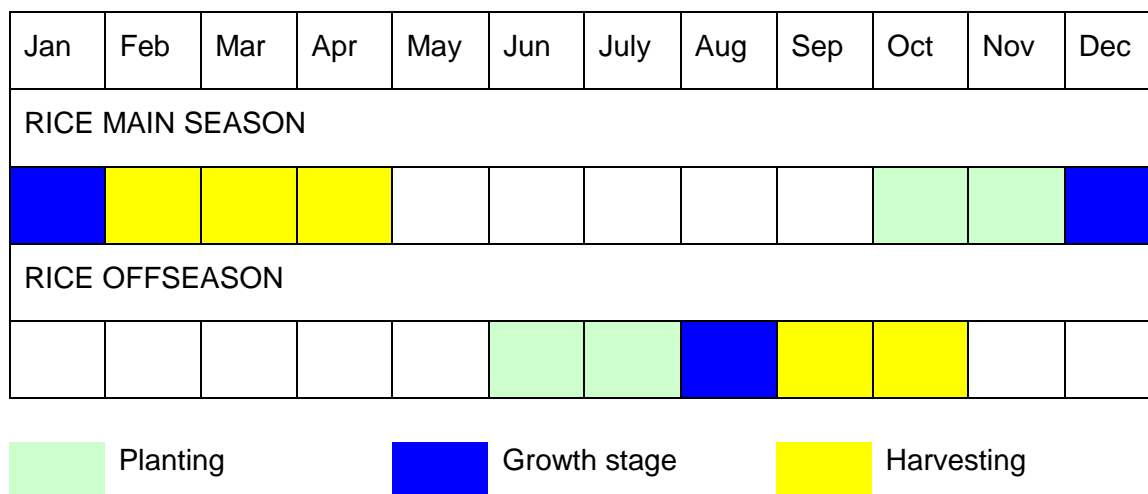


Figure 6. Rice cropping seasons in Fiji

Within the season, rice is grown in the three major ecosystems, namely irrigated, rainfed wet land and rainfed dry land.

Irrigated ecosystem was formed with the construction of irrigation schemes in 1970s in the Central Division and the North Division, which accounted for 20 percent of the total rice area. In this ecosystem, two rice crops were produced per year.

Rainfed wet land ecosystem is the dominant system of rice production in Fiji, comprising 44 percent of total rice area. Fields are normally submerged with water. In some parts of this ecosystem, two rice crops can be grown annually.

Rainfed dry land ecosystem located in higher elevation where rice is grown only in the wet season with high rainfall or intercropped with other dry land crops like sugar cane. This ecosystem comprised of 36 percent of the total rice area.

6.3. Rice growing areas

The major rice growing areas in Fiji are located in the Northern, Western and Central Division, of which the Northern Division is the rice bowl of the country (Figure 7). In 2010, the distribution of rice production was as follows: 80 percent of the production was from the North, 15 percent from the West and 5 percent, in the Central Division. The decrease in rice production in the Central Division was due to the damage to irrigation schemes so farmers have converted rice to other dry land crops.

In the Northern Division, rice is mainly grown in rural areas of western Macuata and Bua Province. The main production areas are in the Dreketi Irrigation Project areas, sugar cane belt areas of Macuata, Nasarawaqa, Korokadi Irrigation Projects areas and in the Bua flats. In the Central Division, rice is mainly concentrated within Navua areas. For the Western Division, there is a sporadic spread of production areas depending on rainfed conditions where the concentration depends on the pattern of rainfall. Generally the main areas in the West are Ra Province, Northwestern region of Ba Province and portions of the Nadroga/Navosa Province.

Data from Fiji National Agricultural Census (2009) showed rice production was predominated by the North Division, while in Central Division rice production was almost negligible (Table 3).

Table 3. Regional-wise rice production in Fiji (Fiji National Agricultural Census, 2009)

	North Division	Central Division	West Division	Total Fiji
No. of rice farms	2 696	25	101	2 822
Harvested area (ha)	2 825	1.65	27.56	2 854
Milled rice production (tonnes)	4 265	5.7	16.3	4 287
Milled rice yield (kg/ha)	732	3,454	591	1 502

6.4. Rice farm size

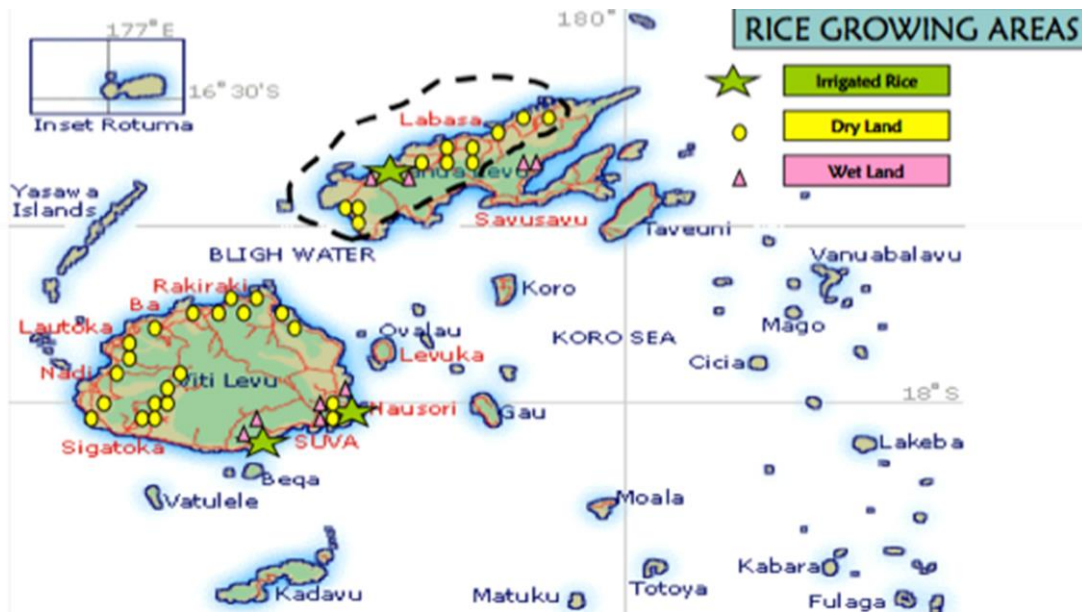


Figure 7. Rice growing areas and ecosystems in Fiji
Adapted from Kamlesh Puran, Fiji Ministry of Agriculture, 2011

Data from the Fiji National Agriculture Census (2009) show the distribution of rice farm size in Fiji as given in Table 4. There were 2 823 rice farms in Fiji, of which small-scale farm (<2 ha) and medium-scale farm (3-5 ha) comprised 26.5 percent and 13.9 percent, respectively. It is important to note that farms having size of 5-10 ha occupied a high proportion as 34.8 percent. Rice farm size of 10-20 ha comprised 18.6 percent. The proportion of rice farm size of 20-50 ha was 5.8 percent, and only 0.3 percent of the total rice farms had above 50 ha. High yields were recorded in farms with a size of 10-20 ha and 20-30 ha. Farm size below 1 ha gave the lowest yield.

The farm size of rice in Fiji is larger than the average size of all farms in Fiji. The total of all farms in Fiji was 65 033, of which farm less than 1 ha comprised up to 43.9 percent. Farms of 1-5 ha, 5-10 ha, and 10-20 ha comprised a proportion of 38.7 percent, 10.6 percent and 4.7 percent, respectively (Fiji National Agriculture Census (2009)).

Table 4. Rice farm size in Fiji (Fiji National Agriculture Census, 2009)

	Farm	Area (ha)	Harvested (ha)	Production (kg)	Yield (kg/ha)
<1 ha	147 (5.2%)	56.24	53.96	79 483	454
1-2 ha	601 (21.3%)	715.75	579.55	721 207	1244
3-5 ha	392 (13.9%)	841.69	598.53	777 659	1299
5-10 ha	983 (34.8%)	1 113.27	928.18	1 171 488	1262
10-20 ha	525 (18.6%)	709.24	520.90	924 694	1778
20-50 ha	165 (5.8%)	178.27	166.26	602 646	3625
50-100 ha	7 (0.2%)	6.34	4.32	5 839	1352
>100 ha	3 (0.1%)	2.71	2.71	4 500	1660
Total	2 823 (100%)	3 632.51	2 854.21	4 287 526	1502

6.5 Rice varieties

There are two groups of rice varieties grown in Fiji. The first group consists of traditional varieties, which have long durations of 5-6 months, and low yields (2 tonnes/ha). Traditional varieties were planted to 80 percent of the rainfed wet land areas. Farmers in wet land and dry land rainfed areas prefer to grow these varieties because they possess good tolerance to adverse conditions like drought or water inundation and good eating quality. Common traditional varieties included BG75, Saraya-6 Months, China Motka, Lalka Motka, Takur Ram and Ram Kajra. The other traditional varieties grown in the far past like Rewa Patna, China Patna, Motmuria, Sareya Patna, Golka, and New Guinea have not been known to exist at present.

The second group consists of improved rice varieties, which were bred for high yield potential of more than 6 tonnes/ha, short growth duration, short (semi-dwarf) plant height and resistance to lodging. These varieties are suited to the areas growing two rice crops per year. Common improved varieties being used in production include Boldgrain, Uttam, Maleka, Deepak, Totoka, Nuinui and Star. In mechanized rice production, The Grace Road Food Company has found the best rice varieties suited for local conditions as Star, Totoka, Nuinui and Deepak to give yields of 6-8 tonnes/ha. Star has the shortest growth duration (90-110 days) while other varieties have medium growth duration like Nuinui with 125-130 days and Deepak with 130-140 days. Farmers normally prefer improved varieties with short growth duration.

Farmers, while planting improved varieties for sale, still maintained traditional varieties to grow separately in small plots for their own home consumption. For example, farmers in Dreketi grew separately a special traditional variety, namely Usar Mothka for family consumption, and other improved varieties like Star, Bolgrain were planted for sale.

6.6. Rice irrigation schemes

During the mission, the international consultant visited 04 irrigation schemes in the Northern Division (Dreketi, Nasarawaga, Naruwai and Korokadi) and 01 scheme (Lakena) in the Central Division.

- Dreketi scheme was constructed in 1971 with the irrigation capacity of about 1 000 ha covering three stages (zones). At present the scheme is still working, however the irrigation capacity in the dry season has been reduced, so irrigation covering was only partial in the stage 3 in dry season. The scheme needs to be upgraded, particularly dredging of the canals from the main gate to the fields. If the financial investments were available, a permanent cement construction of the canals would be an optimal option to improve the efficiency of the scheme.

- Nasarawaga irrigation scheme (Bua province) had the irrigation capacity of about 100 ha. The scheme recently stopped working due to the damage of the underground tube connecting the main gate to the open in a distance of 300 meters, so water cannot flow to the canal in dry season, although water resource is available at the dam. The damage needs to be repaired to allow planting of offseason rice.

- Naruwai irrigation scheme and Korokadi irrigation scheme have the irrigation capacity of 50 ha and 170 ha, respectively. Both the schemes are working well. However, upgrading of canals is necessary to improve the efficiency of the schemes.

- Lakena irrigation scheme (Tailevu province) had a capacity of around 1 000 ha in the past, but as its pumping station to take water from the Rewa River to the canal was damaged and the canal was also degraded. Farmers converted rice area to upland crops like taro or vegetables.

6.7. Farm mechanization

Rice production in Fiji has been facing the severe shortage of labor plus the aging of farmers leading to low productivity and high production cost. Therefore, the Government has given strong supports for the promotion of mechanization in rice production. Incentives were granted to the farmers in the forms of provision of machines for hiring at a low price or price subsidy to purchase the machines.

Large machines like 4-wheel tractors, transplanting machines or combined harvesters have been used by farmers in the irrigated rice projects or by large scale in rice commercial production, meanwhile small machines like tiller, reaper or thrasher are also available for small-scale farmers. A farmer in Koronubu, Ba province recorded that to harvest acre of rice, he usually spent FJ\$ 500 on laborers, but by using the harvester, he only spent FJ\$ 17 in an hour to complete harvesting. According to principal agricultural officer West Vinesh Kumar, there were about 20 large-scale rice farmers in the West who owned more

than five or six acres of rice farms. There are two combined harvesters in the West used by farmers from Sigatoka to Rakiraki. Similarly, in the Province of Rewa and other potential rice growing areas, the Ministry of Agriculture organized rice field days to demonstrate the use of small rice machines such as the rice reaper and thresher as well as training farmers improved cultural practices in growing rice.

6.8. Production technology recommended for the Fijian farmers

Technology guidance of rice production is presented in the Fiji Farm Management Manual, which is published by the Ministry of Agriculture in 2014. Features of this guidance are as follows:

Feature	Wet land rice	Dry land rice
Varieties recommended	<ul style="list-style-type: none"> - Improved varieties <li style="padding-left: 20px;">Bold grain <li style="padding-left: 20px;">Deepak <li style="padding-left: 20px;">Nuinui Star <li style="padding-left: 20px;">Uttam - Traditional varieties: <li style="padding-left: 20px;">BG 	<ul style="list-style-type: none"> Bold grain Deepak Maleka Nuinui Star Totoka Uttam
Seed rate	Seed rate: 80 kg/ha. Spacing: <ul style="list-style-type: none"> - Between rows: 25 cm. - Plants within rows: 20 cm. For transplanted rice: 30 kg/ha, transplanting space of 30 cm × 20 cm with 3-4 seedlings per using 21 days old seedlings.	Seed rate: 100 kg/ha. Spacing: <ul style="list-style-type: none"> - Between rows: 20 cm. - Plants within rows: 15 cm. Dropping seeds in furrows or using seed drill @ a depth of 4-6 cm. If broadcasting, this should be evenly broadcasted.
Cropping season	Can be planted all year around.	Wet season (November to February).
Fertilizer application	<ul style="list-style-type: none"> - Superphosphate: 125 kg/ha @ planting. - Muriate of Potash: 125 kg/ha @ planting. - Urea: 125 kg/ha - in 2 split application: 21 days and 60 days after germination. Soil analysis should be done before fertilizer application.	Same as in wet season.
Weed control	<ul style="list-style-type: none"> - Narrow leaves: applying Propal @ 340 ml/15 L of water @ 3-4 leaf stages. - Broad leaves: applying MCPA @ 100 ml/ 15 L of water. 	Same as in wet season.
Disease Control	<ul style="list-style-type: none"> - Brown spot: maintaining fertility. - Sheath rot: Avoid closer 	Same as in wet season.

	spacing high level of nitrogen. - Stem rot: using resistant variety. - Root rot: using recommended soil fertility level. - Blast: using resistant varieties.	
Insect Control	- Plant hoppers: spraying Acephate (Sunthene) 12 g/16 L of water or Diazinon @ 48 ml/ 16 L of water - Rice leaf rollers: applying Diazinon 48 ml/16 L of water - Rice army worm: spraying Acephate (Sunthene) at 12 g/16 L of water	Same as in wet season.
Harvest and yield expected	Harvesting after 60 to 80 days from planting. Yield: 2 to 3 tonnes/ha for dry grains.	Harvesting after 90 days from planting. Yield: 3 to 4 tonnes/ha for Star, Maleka and Totoka; 4-5 tonnes/ha for Uttam and Nuinui.

Novel technology options should be supplemented in the technological guidance:

- Minimal tillage in land preparation to conserve soil fertility.
- Use of organic fertilizers to reduce the application rate of chemical fertilizers. The quantity of organic fertilizers applied depending on the local availability, preferably at 5 tonnes/ha.
- The application of SRI in rice production is feasible, but in the case of Fiji where labor is scarce, this method should be modified for mechanization.
- The technology of alternate wetting and drying (AWD) irrigation would be relevant in the case of Fiji to save irrigated water in dry season in the irrigated ecosystems and reduce methane emissions from rice fields.

6.9. Cost and return analysis of rice production in Fiji

Cost and return analysis of rice production in Fiji is given in the Fiji Farm Management Manual, which was published by the Ministry of Agriculture in 2014.

For wet land rice production:

Total variable cost of production is estimated at FJ\$ 3 477/ha for wet land rice and FJ\$ 3,960/ha for dry land. To assume that with these levels of production investment, milled rice yield is 3 tonnes/ha, of which 2.7 tonnes/ha are sold (90 percent), the production cost would be FS\$ 1.3/kg milled rice in the wet season and FJ\$ 1.5/kg in the dry season. Based on this assumption, the gross margin per hectare depends on the price of rice sold which at present is normally at FS\$ 1.5/kg, indicating that the gross margin per hectare is FJ\$

573 USD for wet land rice but is only FJ\$ 90 for dry land rice. Therefore, it is widely reported that the high cost of rice production and low profitability of rice farming have made Fiji rice less competitive as compared to imported rice.

For farmers, if the paddy price is FJ\$ 750/tonne, the paddy yield per hectare should be above 4 tonnes, so that they can get some profits from rice farming.

The rice production cost and gross margin in Fiji as compared to Vietnam and Thailand, of which rice was imported to Fiji, are given in Table 5. Data show both the total rice production cost per hectare and per tonne was highest in Fiji. Fiji also had lowest gross margin per hectare. The farm gate paddy price in Fiji was higher as compared to Vietnam, but lower as compared to Thailand.

Table 5. Comparisons of rice production cost and gross margin per hectare in Fiji, Vietnam and Thailand (2014)

	Fiji	Vietnam	Thailand
Farm gate paddy price (US\$/tonne)	367	224	406
Total production cost per hectare (US\$)	1 704	1 097	1 366
Total production cost per tonne of paddy (US\$)	637	158	246
Net return (US\$/ha)	280	650	893

Fiji data based on Fiji Farm Management Manual, which is published by the Ministry of Agriculture in 2014 for wet land rice. Vietnam and Thailand data based on Dao The Anh (2016): A report on needs to renovate technologies in rice production and post harvest in Vietnam

6.10. Rice value chain in Fiji

There are three major forms in the rice value chain in Fiji: (1) rice locally produced by small-scale farmers mainly for family consumption (2) rice locally produced in irrigation schemes or large-scale farmers, and (3) rice imported.

Small-scale farmers grow traditional rice varieties in the rainfed areas or in the intercropping or rotation cropping systems with upland crops like sugar cane. Farmers applies traditional farming practices with low inputs, thus the yields are low. Produces are mainly used for home consumption, and if there is still a surplus, paddy is stored temporarily in the house and sold later to the middlemen or it is milled at the small milling machines in the areas, and rice is sold in local markets or to neighbors. Traditional marketing channels, which connected small-scale farmers with small mills and local markets, have been recognized as efficient in a subsistence farming system particularly for traditional varieties. There was no direct price support for this marketing channel and the prices depended on the varieties and quality. The prices for local rice in Municipal

markets range from FJ\$ 1.2-1.50 per kg. There is no inter-island trade in rice produced from traditional varieties.

Marketing of rice locally produced from improved varieties in the Government-supported irrigation schemes or from large-scale farmers was mainly done by Rewa Rice Ltd., which has a large-scale milling factory in Dreketi. The factory was built in the early 1970s and at present, it is still working, but the equipment became very old and outdated.

Farmers transport paddy to the factory, which purchases paddy at prices based on the moisture content as follows:

Grade 1: Moisture content below 15.4 percent - price of FJ\$ 750 per tonne.

Grade 2: Moisture content from 15.5 - 18.4 percent - price of FJ\$ 700 per tonne.

Grade 3: Moisture content from 18.5-21.0 percent - price of FJ\$ 650 per tonne.

Rewa Rice Ltd is a public enterprise, which determines the price of rice in consultation with the National Rice Task. To support farmers, the Government granted a subsidy level of FJ\$ 100 per tonne of paddy to the company for purchase of paddy from the farmers.

Apart from Rewa Rice Ltd., Fiji currently has 4 other milling companies, including Visama Rice Mill, Evergreen, Rice Company of Fiji Ltd. and Punja & Sons (Rice) Ltd. All these companies are millers. However, the Rice Company of Fiji and Punja & Sons are the only companies which process rice into rice flour and husk as stock feed sold as meal mix.

It is informed that Rewa Rice Ltd. is going to install a new mill in late 2016 at Muanidevo in Dreketi. The new mill purchase by the company from China is worth of FJ\$ 200 000. The new mill will be installed besides the existing old mill, which was also located in Dreketi to increase the capacity of paddy purchased and processing which could help encourage rice production.

The pricing for rice is always done by the Public Enterprise in consultation with the Rice Taskforce. The current price is of paddy is \$750 per tonne.

Marketing of imported rice: The three major licensed importers of rice in Fiji are Rewa Rice Ltd., Punjas & Sons Ltd. and Visama Rice Ltd. There are other small licensed importers. Surveys at the supermarket in Suva city (in September 2016) recorded that a majority of imported rice is from Vietnam (package done in Australia or Fiji) and high rice quality rice with Indian or Thailand brands is imported from India and Thailand. Brown rice is brought from Australia and the polishing of imported brown rice is done in Nausori, Lautoka and Dreketi. In the supermarket, local rice brand, namely Rewa rice is also sold, but quantity is very small and a new Fiji rice brand rice o produced by the Grace Road Company was also seen in the market but the availability of this brand is limited.

The price of rice sold supermarket is given in Table 6. It is observed that local rice is sold

at a higher price of medium quality imported rice, but the high quality rice imported from India and Thailand is sold with very high price. The average price of imported rice in the last six years is around FJ\$ 1/kg indicating that Fiji mainly imported low quality to medium quality rice, which is suited to the majority of the consumers. Such prices are more competitive as compared to the price of Rewarice, the popular Fiji rice brand which is sold at FJ\$1.67. The imported segment of high quality rice (from Thailand and India) is very thin to serve only the high-income consumers.

The purchase of paddy from farmers under the subsidy scheme of the Government is mainly done by Rewa Rice Ltd., a state-owned company. During the visit of the Minister of Agriculture, Mr. Inia Seruiratu to Dreketi in June 2016, farmers in Kreketi complained that Rewa Rice Ltd could not purchase their paddy timely while they did not have proper storage facilities causing decrease in their income. In this backdrop, the recent establishment large-scale mills owned by private companies like the Grace Road Company have been much rewarding because it would make the rice market more transparent and competitive.

In summary, the status of stakeholders in the value chain is summarized in Table 7.

Table 6: Price of rice in the supermarket in Suva city (September 2016)

Brand/Company	Origin	Price (FJ\$/kg)	Remark
Rewarice Sunluv (Rewa Rice Ltd.)	Fiji	1.67	Packed in Fiji
Grace Road Lal Jari Rice	Fiji	2.97	Packed in Fiji
Premium Long Grain (Punja & Sons Rice Ltd.)	Vietnam	1.30	Packed in Fiji
SunRice White Long Grain (FMF)	Vietnam	2.10	Packed in Australia
White Fragrant Jasmine Rice (FMF)	Vietnam	1.79	Packed in Australia
Umbrella Fragrant (CP Group)	Thailand	3.48	Packed in Thailand
Daawat Basmati	India	6.10	Packed in India

Table 7. Present status of stakeholders in the rice value chain in Fiji

Farmers/Farming	Input providers	Middleman	Processing	Market/trade	Consumers
<ul style="list-style-type: none"> - Small-scale farmers, subsistence production - Low level of technology adoptions and mechanization - Aging of farmers - High production cost 	Limited number of providers, particularly rice seeds	Lack of support facilities, particularly storage and transportation	Both large-scale and small-scale rice milling are outdated resulted in low efficiency and low quality	<ul style="list-style-type: none"> - High demand of rice - Local rice products are less competitive (expensive, low quality and inferior package) 	High preference of imported rice

- Paddy price subsidy			leading to high processing margin	- Monopoly of Rewa Rice Ltd. in paddy purchase supported by the Government	
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6.11. Rice research and extension

Rice research

Agricultural research in Fiji was carried out by the Research Division of the Ministry of Agriculture (previously as the Ministry of Primary Industry). The Research Division has the mandate to complement and support the Ministry of Agriculture through the development of new technologies and its transfer to suit the need of farmers, the clients and the stakeholders for the enhancement of the agricultural sector through applied research. The research scope of the Division is on the agronomy of crop development excluding sugar and on providing services to the agricultural sector.

Under the Research Division, there were several research stations located in different Divisions of the country, of which the largest station is Koronivia Research Station, which was founded in 1942 located in Koronivia near Suva City. Most of rice research has been done in the Koronivia Research Station.

Rice research in Fiji has a long history. The cooperation of Fiji with the International Rice Research Institute (IRRI) started in the 1960s, the early years of this institute establishment, particularly in the improvement of rice varieties and training of rice scientists. Most of the improved rice varieties developed in Fiji were derived from the exploitation of IRRI rice germplasm.

At present, the Rice Research Section has 12 ha in Koronivia and 20 ha in Kreketi for rice research and seed production, but there are only 4 key officers of which 3 stationed in Koronivia and one in Kreketi. On-going research has included the testing of 40 new promising rice varieties including exotic ones, application of mechanization (rice planting machine) in rice production, monitoring of rice pests and conservation of rice germplasm consisting of more than 200 rice varieties, most of them are Fiji traditional rice varieties. Recently, rice breeding activities have been strengthened with the cooperation of Chinese experts.

In Fiji, rice seed production is done by the Rice Research Section with limited resource capacities. At Koronivia, the total seed quantity produced is 35 tonnes per year. Seeds are sold at a price of FJ\$ 14.0 for 30 kg. The international consultant observed that seed production in the fields is well managed as the crop is highly uniform and free of weed

infestation, but the seed processing facilities are outdated affecting the seed quality. Apparently, the quantity of seeds produced by Rice Research Section has not sufficient to provide to farmers; but at present, there were no private companies working in rice seed production and trade in Fiji.

Rice extension

Extension services in Fiji are divided within four Divisions of the country and the officers are distributed as widely as possible in all the main agricultural zones to have a close and continuous contact with farmers.

Their role is to diffuse the research results (technology transfer) to the farmers on all crop commodities not only in rice and provide infrastructural support for improvement of the agricultural sector.

Extension services have also become heavily involved in a wide range of activities: input supply, administration of credit, market, policing of regulations and collection of statistics etc.

The low level of extension/research linkages in delivering research results to farmers and the need to properly extend appropriate cultural practices for high yielding varieties is lacking in Fiji.

Lack of knowledge and skills, staffing level (1:1,200 farmers), harsh working conditions and housing, remoteness and communication, less resources such as transportation, many crops to look after, are the attributes of low level of technology transfer in Fiji especially to rice production. In a province, there are around 10 extension officers who take care of all crops; among them some are allotted for the rice program.

6.12. Review of FAO supporting project

Background

In view of the serious decline of Fiji rice production, FAO has supported the Fiji Government the project on "First Season-Long Training of Trainers (ToT) on Integrated Rice Crop Management under the National Rice Revitalization Program of the Ministry of Agriculture (MoA)" to contribute to the increase of Fiji rice production to meet the 2020 target of self-sufficiency set by the Government. Field trainers and farmers apply new skills leading to sustainable rice production and productivity increase. Moreover, these skilled trainers again train field workers and farmers on improved and new rice production techniques. The project budget was US\$ 344 178 funded by FAO with the implementation period from July 2014 to June 2016 to achieve four following outputs:

Output 1: Five Field trial sites and experiment plots established.

Output 2: At least 25 field trainers trained to apply new training on rice production methodologies.

Output 3: At least 50 selected farmers trained to apply new sustainable rice production technologies.

Output 4: Extension material, curriculum and training materials, for FFS and TOT developed.

Achievements of outputs

(1) Five Integrated Rice Crop Management Field Schools in 5 villages in Dreketi (Malawai, Naibulu, Manidevo, Droca and Vuniotu) were established and implemented in the first week January 2015. The training practicum activities were done through the conduct of Integrated Rice Crop Management Field School. A total of 100 farmers these FFS, (50 percent of them were women) were also graduated on IRCM and also learnt other management skills.

(2) Twenty four field trainers who are Agriculture field staffs (Both Extension and Research) under MoA of different provinces of Fiji were trained to apply new training on rice production methodologies. Among the participants, 28 percent were female and 72 percent were male; and the average age of female and male trainees were 26 and 35, respectively. The teaching-learning activities comprised of around 30 percent field practicum (Trial plots run by the participants) and exercises (Practical exercise in the class and field), 20 percent workshop (participatory workshop-discussion), 20 percent participatory lecture-discussion (by the participants-writing reports/ analyzing lecture notes/ preparing questions etc.); and inputting 20 percent training facilitation in the affiliated Integrated Rice Crop Management in FFS and 10 percent field observation through educational tours.

- At the end of the course, the participants acknowledge that that following topics were addressed during the training program:
- Seed cleaning, sorting, incubation and seedbed preparation
- Land preparation
- Transplanting
- Thinning/gap filling
- Water management
- Weeding
- Urea top dressing
- Insect-pest/disease management
- Calculation of fertilizer/seed/yield
- Morphology of rice plant
- Growth phases and stages of rice crop

- Harvesting and storing of rice
- FFS facilitation technique, trial setting, etc.

Recommendations

(1) A majority of the activities in the outputs was furnished with good results reflecting in the improvement of knowledge and skills of the participants through examinations conducted before and after the training. However, some contents relevant to Fiji rice production have not yet addressed, including:

- Mechanized rice production and use of machines (transplanting machines, seeding machines, combined harvesters, etc.)
- Organic rice production
- Costs and return analysis for rice production
- Rice-based cropping systems (intercropping, rotation cropping)

These themes can be added in the FFS conducted in the coming season or in association with the Fiji - China rice cooperation project.

(2) The output "Development of extension material, curriculum and training materials, for FFS and TOT" has not furnished. The draft of the Training Manual and other materials are not available at the present for the international consultant to review.

6.13. Cooperation between Fiji and China in the improvement of the Fiji rice revitalization program

Fiji and China has developed cooperation for supporting the improvement of the Fiji rice revitalization program, with the signing of a Memorandum of Understanding between the Chinese Government and Fiji's Agriculture Ministry in 2014. The support has been implemented by China Shandong International Economic and Technical Cooperation Group Limited in technical partnership with world- known hybrid rice seed company, Yuan Longping High-Tech Agriculture Company Limited.

Under this cooperation framework, a rice development project was formed in Dreketi irrigated areas, Muanicula province, Vanua Levu. The project area of 200 ha has been used to establish, demonstrate and disseminate high yielding rice cultivation techniques to increase yield in large-scale rice production. The Chinese Government has permitted FJ\$10 million for the project in the period from January 2015 over December 2016. Till September 2016, about 10 ha were cultivated following mechanized production technologies. Apart, Chinese experts implemented cooperation with Koronivia Rice Research Center for study to develop new high-yielding varieties.

To support the promotion of mechanization of Fiji rice production, the The China Shandong International Economic and Technical Co-operation Group Limited has provided much-needed assistance to rice farmers in Dreketi and Koronivia – bringing in 11 different models of rice machines from China, worth a total of \$5 million.

In the field trip to the Fiji - China cooperation project site in Dreketi, the international consultant observed that rice in the fields were heavily infested by weeds and irrigation, so weed control appeared to be important in the rice crop management, particularly in applying mechanized production technologies. To bring local rice farmers to the project as production partners is also an important issue to support the formation of a model of a new generation of rice farmers.

6.14. The involvement of private sector in the Fiji rice industry: A successful story of Grace Road Food Company

Established in 2014, Grace Road Food Company (GRC), a Korean Company started with a capital investment of \$320 300 and according to the GRC ever since then it has invested \$F21.3 million in Fiji.

In April of 2014 the company was granted a 50-year lease on an 83-acre land in Deuba outside Navua and at present the Company has leased more than 1 500 acres of land, of which 100 acres of land has been used for rice production

The company invested new \$4 million to build a new milling factory in Navua. The construction has completed by September and the factory is ready for operation. The factory will produce packed rice directly from paddy through a single process (raw paddy-dryer - milling - polishing- color sorting - rice - packing). Through this synchronized, holistic system, GRC is aggressively pushing forward in mass production of high-quality rice. The company has produced its rice brand "Grace Road Rice- Naturally Grown), a small sale of which has been seen in the supermarket in Suva city.

The rice trade policy of the GRC is aimed at high value added for their rice brands by applying organic production approaches which are supported by their own modern milling facility.

6.15. Policy supporting the rice industry

Land policy

Land leases (tenure) were the obstacles to secure long-term rice production and farm investment. In the last years, many Indo-Fijian farmers, along with their families, have been displaced from their homes, which due to the land tenure system in Fiji, where most of sugarcane and rice farms are on the native land on 30-year land leases. These leases began to expire in 1997 with a high rate seen in 1999 and 2000.

The refusal to renew leases forced the farmers to abandon rice farming and migrated to the urban for non-skillful jobs. This movement resulted in a major drain of experienced rice farmers.

It was reported that initially the Dreketi Rice Project had a total of 680 hectares irrigated rice with 221 farmers, but currently the number of farmers dropped to 153. The tremendous decrease in the number of farmers had happened when the new landlord took over the land, so the land owned by farmers reduced to 462 hectares at present. The situation in Dreketi is not an exception case in Fiji as a large portion of existing leases administered under the Agricultural Landlord and Tenant Act (ALTA) are due to expire. Expiry of land leases and unsecured land tenure system prevailed in several areas like Lagalaga, Kurukuru, Wainikoro, Chandmari, Taganikula, Nagigi, Daku, Draladamu, Bororboro, Korokadi, Naselese, Vuniuto, Mouta, Vunivutu etc.

The policy of the Government is to advocate for a mutually satisfactory agreement, which will be accepted by both landowner and tenant. Government has a leadership role to play in assuring that this land issue is resolved.

Subsidy policy

The Ministry of Agriculture has assisted farmers by providing free seeds for new farmers and free rice reaper and rice thrasher for all rice farmers, while fertilizer such as triple super, potash and urea are available to all farmers at a subsidized rate.

The farmers get subsidized machinery renting rates, whereby they pay FJ\$ 17.45 per hour for swamp dozer, combined harvester or wheel loader and FJ\$ 28 per hour for tractor work. If farmers purchase small machines, the subsidy is 2/3 of the machine price and farmers only pay 1/3, for example a tiller costs FJ\$ 7 500, Government subsidizes FJ\$ 5 000 and farmer pays FJ\$ 2 500.

Farmers selling paddy to Rewa Rice Ltd are paid FJ\$ 750 per tonne, of which FJ\$ 100 are subsidized by the Government. Total of subsidy for paddy purchase for Rewa Rice Ltd. valued \$700 000 in 2013 (7 000 tonnes of paddy).

Rice seed subsidy was FJ\$ 13.45 for 30 kg of seeds.

In fertilizer subsidy program, the conditions are set as follows:

Farmers who are actively involved in a cooperative or farmers group, have minimum capacity to cultivate 1-5 acres for small holder farms, and a maximum capacity to cultivate 8 hectares or more for commercial farms of non-sugar cane crops (export and import substitution commodities), has the capacity to pay 25 percent of the cost of inputs. They have duties to sell 50 - 100 percent of their produce to the market depending on farm size.

Information recorded at Kreketi on 13/9/2016, the rates of fertilizer subsidy for rice production are as follows:

- Urea: FJ\$ 18.33 for 50 kg (market price of urea FJ\$ 60-70 for 50 kg)
- Triple super phosphate: FJ\$ 20.82 for 50 kg (market price of TSP FJ\$ 60-70 for 50 kg)

- Monopotash: FJ\$ 25.00 for 50 kg (market price of MoP FJ\$ 70-80 for 50 kg)

Between 2005 and 2007, the Government aimed to increase rice production by 7,500 tonnes valued at FJ\$ 3 million by spending FJ \$2.3 million through the Rice Revitalization Program.

Tariff

Current tariff duty is 3 percent and also duty concession can be applied. Therefore, rice can be landed in Fiji on zero tariffs.

7. Challenges of Fiji rice industry development

The shrinkage of resources, including land and labor for rice production has reached a critical level, resulting in a very wide gap of rice demand for the Fiji people and rice supply from local production. At present, the rice area remains around 4 000 ha with paddy production of 7 000 – 8 000 tonnes per year, while the demand for human consumption reached to 40 000 tonnes of milled rice per year. The migration of laborers in rice farming to urban areas or other rural activities led to a serious shortage of labor in rice production. The termination of agricultural land leases in Fiji (Table 8), including rice land leases has aggravated the departure of farmers from rice farming and some rice areas also disappeared (for other crops or even kept idle). To rehabilitate these resources is the most challenging goal in the revitalization of the Fiji rice industry.

Table 8. Expiring of agricultural land leases in Fiji

Year	No. of Leases	Year	No. of Leases	Year	No. of Leases
1997	135	2008	299	2018	254
1998	237	2009	278	2019	306
1999	1594	2010	374	2020	152
2000	1955	2011	445	2021	168
2001	458	2012	419	2022	135
2002	622	2013	487	2023	148
2003	432	2014	380	2024	88
2004	600	2015	784	2025	85
2005	463	2016	361	2026	65
2006	521	2017	177	2027	54
2007	652			2028	13
Total	13,141				

The slow progress in improvement of rice productivity as the rice yield levels have almost stagnant over decades. There were no breakthroughs in productivity because the adoption of new technologies in rice farming has not been explored to improve traditional methods of rice cultivation. The lack good seeds of the existing varieties and the slow introduction for new varieties and has been the barrier in raising the yield potential. The degradation of irrigation schemes limited attaining the productivity potential in irrigated ecosystem. Further, the rate of mechanization did not keep pace with the labor shortage and the need to increase the production efficiency. Fiji also faced the problem of backwardness in rice processing with the existence of outdated rice processing equipment and mills which were installed in a long time ago, resulting high postharvest loss, low milling efficiency and low quality of milled rice.

The low productivity and low efficiency in rice production and processing have resulted in high cost of rice production in Fiji, as compared to other rice-growing countries, including

those being exporting rice to Fiji, and low profits for rice farmers and other stakeholders in the value chain, which made rice produced in Fiji less competitive than imported rice. For the consumers, as their choices depend on price and quality imported rice is more attractive due to better quality and packing, while the price is normally equal or lower than locally produced rice. The low competitiveness of the Fiji rice industry is a difficulty to be overcome in the present period of increased international trade.

The capacities in rice research and extension; particularly human resources have hampered the development and transferred new technologies. There is a lack of private sector participation in provision of production services, for example seeds or agro inputs.

Government has the willingness and political commitment to revitalize the rice industry but its investment for Rice Revitalisation Programme is still small and not sufficient. During 2011 -2017, total Government's spending for the Rice Revitalisation Programme was FJ\$ 6 150 000 (Table 9) or FJ\$ 1 025 000 per year. In 2016-2017 the spending is projected as FJ\$ 1 000 000.

Table 9. Government's spending for the Rice Revitalisation Programme (FJ\$) from 2011-2016

2011	2012	2013	2014	2015	2016	2016-2017
300 000	600 000	1 500 000	1 500 000	900 000	350 000	1 000 000

Source: Extension Division, Ministry of Agriculture

8. Opportunities of Fiji rice industry development

More than ever, the Government of Fiji has shown the national determination to gain self-sufficiency in rice for ensuring food security and improving livelihood of the farmers. The Government has opened up decisive roads leading to modernization of the rice industry, which included (1) promotion of large-scale commercial rice farming and (2) strong advocacy of mechanization of the rice industry. Along with these strategic breakthroughs, it should be noted that recently there have been new advancements in the Fiji rice industry. They were the flow of foreign investment in the rice sector with the most exemplary success of the Grace Road Company, which in a short time has developed a novel rice value chain in Fiji and the expansion of international cooperation, in which China has transferred new technologies and machines to demonstrate large-scale rice farming in Fiji. The support given by international development agencies, particularly FAO has resulted in positive impacts on rice development in Fiji.

The determination of the Government could be realized through exploitation of the advantages in rice development that Fiji can explore, including:

- Large untapped land in rainfed areas suitable to rice production, including large-scale commercial rice farming and large scope to increase rice area through the practice of intercropping or rotation cropping systems.
- High potential in increase of rice productivity by technology innovations (new varieties, good seeds, new production techniques and mechanization) and irrigation improvement.
- High potential to extract the involvement of private sector in developing the rice industry and to mobilize international financial funds.
- Traditional rice varieties can be exploited for producing speciality rice, naturally grown rice or organic rice for high value added.
- Availability of extension system establishment from central to local levels and foundation of rice research and development, which can be further strengthened.

9. Recommendations for the development of the Fijian Rice Industry

9.1. Vision

Development of a viable and competitive rice industry to attain self sufficiency in rice as a staple food for ensuring food and nutrition security, economic growth and prosperity for rice farmers and other members working in the rice industry.

9.2 Mission

To increase rice production and reduce rice imports; enhance competitiveness of Fiji rice; improve income and livelihood of rice farmers; and to contribute to strengthening of national food and nutrition security.

9.3. Strategic objectives

To translate the vision into a reality, there are five following strategic objectives to guide the implementation of actions and programs for restructuring of the Fiji rice industry.

(1) Increase of rice area and rice productivity through exploitation of untapped land resources and under-utilized rice land in couple with promotion of application of novel technologies in production.

(2) Modernization of the rice industry through mechanization, improved postharvest technologies and milling facilities in couple with establishment of efficient value chain.

(3) Promotion of production organization focusing on expansion of large-scale commercial rice production.

(4) Development of efficient domestic rice market and enhancement of competitiveness of Fiji rice.

(5) Advocacy of favorable policy interventions through institutional reforms and increased investment for infrastructure and science and technology development.

9.4. Actions and programs

Guided by the strategic objectives, at least seven themes can be selected for development of actions and programs as given in Table 10 and described below.

Table 10. Themes for development of actions and programs

No.	Theme
1	Increase of rice area
2	Sustainable increase of rice productivity in all rice ecosystems
3	Organization of rice production to facilitate large-scale commercial farming
4	Mechanization of rice production
5	Improvement of rice postharvest, processing and value chain
6	Strengthening of rice research and technology transfer
7	Policy and institutional reforms

(1) Increase of rice area

It is feasible to increase of rice area in a stepwise manner. At the first step, prioritized actions would include:

- Utilization of untapped land for rice farming

There are large areas suitable in rainfed wet land or dry land ecosystems for rice cultivation but are not utilized or abandoned due to various reasons like termination of leases, limited capacity of the land owners to organize farming or location remoteness. According to the document (draft) of Rice Industry Plan prepared by Fiji Ministry of Agriculture (2016), the area can be expanded for rice production as 5,762 ha to increase the total rice area to 8,167 ha from the present level of 2,405 ha (Table 11). Most of the possible increase of rice areas comes from the Northern Division with 66 percent (3,787 ha) followed by Central Division with 22 percent (1,294 ha) and Western Division with 12 percent (680 ha).

Table 11. Potential areas (ha) for rice production

Location	Potential rice area	Current rice area	Area can be expanded for rice production
<i>Northern Division</i>			
Macuata	4 189	1 645	2 544
Bua	1 723	614.5	1 108.5
Cakaudrove	156	20.8	135.2
<i>Central Division</i>			
Navua East	1 222	56.0	1 166
Navua West	108	0	108
Vunaniu	20	0	20
<i>Western Division</i>			
Ra	441	13.0	428
Ba [Northwest]	219	45.0	174
Nadroga/Navosa	89	10.5	78.5
Total	8 167	2 405	5 762.2

Some policies should be advocated to facilitate the utilization of untapped land for rice production, including:

- Motivating the large-scale landowners to bring idle land to rice production or give leases to farmers.
- Facilitating the access to land by private sector to invest in rice production, processing and value chain.
- Incentives given to farmers to expand rice area.
- Expansion of rice area by practices of doubled rice cropping, triple rice cropping, rice-based inter-cropping or rotation cropping.
- Upgrading and rehabilitation of existing irrigation systems to ensure the planting of two rice crops per year.

The irrigation schemes in the Northern Division, including Dreketi, Nasarawaqa, Naruwai and Korokad need to be upgraded to exploit their capacity to ensure sufficient water supply for two rice crops per year. The irrigation schemes in the Central Division, including Navua East and Lakena were totally damaged need to be rebuilt.

- Growing two rice crops per year in the favorable rainfed ecosystems, where rainfall is ambient instead of single rice crop per year.

- Exploitation of the diversification of rice-based cropping systems; encouraging farmers to practice intercropping, particularly rice with sugar cane or rotational systems like vegetable-rice or sugarcane-rice of the Western region of Viti Levu and Northern region of Vanua Levu by providing technology support, for example supply of seed of short duration high yielding varieties.

(2) Sustainable increase of rice productivity in all rice ecosystems

There is a large scope to increase the rice productivity in view of the favorable climatic and environmental conditions for rice cultivation in Fiji as shown in the case of good crop management practices in the fields of Grace Road Company or Fiji-China cooperation project, the yield could attain 6 tonnes/ha or more, while the yield level in Fiji varies from 2.5-3.0 tonne/ha. This indicates that the gap of actual yield to attainable yield is

is around 3 tonnes/ha. Therefore, it is possible to increase the yield in irrigated ecosystems to 6 tonnes/ha and rainfed ecosystems to 4 tonnes/ha or on the average the national yield will attain 5 tonnes/ha.

In the short run, if the actions to increase the rice area to 8 000 ha and rice yield to 5 tonnes/ha are achieved, the rice production will reach 40 000 tonnes per year equivalent to 26 000 tonnes of milled rice. With this capacity of domestic production, Fiji could attain 60% self-sufficiency in rice by 2020.

To sustainably increase rice productivity, prioritized program should be focused on:

- Breeding of new rice varieties to replace the existing ones, focusing on high yield and short growth duration (90-100 days) for irrigated ecosystem, intercropping or rotational cropping systems, and for doubled rice cropping in rainfed ecosystems, and new varieties for drought tolerance and aerobic varieties for rainfed upland ecosystem. The development of new rice varieties can also be achieved by testing of exotic varieties introduced to Fiji by international cooperation. To meet the quality demand of Fiji rice consumers who are acquainted with quality of imported rice, the new rice varieties should not only have high yield but also good quality suited to the preference of Fiji people.
- Conservation and utilization of selected traditional varieties possessing super grain quality for planting in certain rainfed ecosystems.
- Promoting the seed production and seed supply system to ensure good quality seeds of recommended varieties accessible by farmers. Encouraging private companies to invest in seed business.

- Increase of the adoption of package of good agricultural practices (GAP) following the approach of “Save and Grow” based Climate-Smart Agriculture (to lower input use and reduce production cost, but increase productivity and profit), focusing on water and nutrient management, organic rice production, conservation farming and soil conservation techniques in rainfed upland.
- Improvement of the provision of agro inputs to meet the needs of rice farmers in all rice growing area, and the availability of suitable types of agro inputs for rice, for example single element fertilizers.
- Intensifying the extension activities to effectively transfer technology to farmers, focusing on promotion of farmers field school (FFS).

Improved varieties, good seeds and efficient nutrient and water management are key technologies to fast increase rice productivity in Fiji.

(3) Organization of rice production

In Fiji, two major types of rice production organizations, small-scale of individual smallholder farmers and large-scale commercial production of farmers or companies have existed. Rice production based on individual smallholder farmers is inefficient; particularly it hinders the application of new technologies and mechanization and the connection with market.

The directions of organization of rice production in Fiji are to facilitate the transformation of small-scale production to a bigger scale through cooperation mechanisms among smallholder farmers, at the same time promotion of land consolidation and large-scale commercialization.

Smallholder farmers can organized in various forms of cooperation. The most popular forms include cooperatives, farmers clubs, self-help groups, farmers interest group or contract farming, rice grower associations (for a locality or a special product). Government through Agricultural Extension Division helps famers to organize suitable cooperative forms and supports training farmers in management skills.

(4) Mechanization of rice production

Mechanization of rice production has been identified as a key factor to transform Fiji rice industry. There have been many demonstrations showing the benefits of mechanization in rice production and postharvest. The only matter is to speed up the pace of applications that suit to different types of farming. Large machines like combined harvesters were

suitable for large farms, but small and light machines were more efficient in small-scale farming and easy for operation in fragmented fields.

The subsidy support of the Government to rice mechanization is well justified. The rate of subsidy should be in the range of 1/3 - 2/3 of machine's value depending on the type of machines. Besides, the machine hiring system controlled by the Government needs to be strengthened to provide services timely as required by rice farmers, particularly small-scale farmers. Quality of public services is a matter to be addressed. The machine hiring system operated by the private sector or farm cooperatives should be encouraged.

Besides subsidy support, it is also essential to promote simultaneously measures to facilitate the application of machines in rice farming, including (1) exemption of import tax on agricultural machine import (2) promotion of land consolidation and large-scale commercial farming (3) organization of smallholder farmers in cooperative, farmer group, contract farming, etc. to invest and utilize machines in a joint scheme. (3) Government's investment in roads to rice growing areas to facilitate machine's movement, and (4) Training of farmers to use and maintain machines and training of skilled mechanics for agricultural mechanization development.

(5) Improvement of rice postharvest, processing and value chain

Improvement of postharvest and processing supports the reduction of postharvest loss and increase of rice quality.

Storage is an important chain in rice postharvest, and at present the rice storage facility is weak in Fiji. So, the facilitation for building storage facilities suited at farm, district level, provincial and company levels are urgently needed to address.

Another urgent action is to improve rice mills in Fiji, both large and small-scale ones, which almost all were outdated and performed poorly. The existing old mill of Rewa Rice Ltd at Dreketi needs to be renovated. The rice processing industry in Fiji has entered a period of reform with the operation of a new modern mill in Navua (Viti Levu) built by Grace Road Food Company. Besides, Rewa Rice Ltd has prepared to build a new rice mill at Muanidevo in Dreketi late this year. These development trends should be encouraged and supported.

The value chain of domestic rice has a role to connect all the improvements in every step from rice production, postharvest and processing to the consumers in an integrated way that value added should be accumulated in each step. In Fiji the connection of stakeholders in the rice value chain should be established, at least on the linkage of small-scale farmers with miller/trader on an equal sharing of benefit. In higher levels of the rice value chain, the large-scale farmer's commercial production or large-scale production and processing operated by private sector (model of Grace Road Company) could form an integrated rice value chain.

Further, to improve the efficiency of rice value chain in Fiji, the cost of rice production should be reduced to enlarge the value added for farmers and the high cost in processing margin and wholesale trade margin of locally produced rice should also needs to reduce through improvements to be made in rice processing and market.

To regenerate more value added in the rice products, Fiji has the advantage of environmental endowments to produce rice of speciality like organic rice or naturally grown rice for market niches. The effective utilization of rice-based products (rice hull, straw, bran) to produce high-value products like biochar, organic fertilizer, mushroom and rice bran oil, etc., and the production of animal feeds from rice-based products can also generate additional value added in the rice value chain.

To advocate the image of Fiji rice, it is essential to issue the quality standards of Fiji rice and the quality certification logo of the Government. Guidance and standards of "Good Agricultural Practices - GAP- Rice) should be promulgated to ensure food safety for the rice consumers.

(6) Strengthening of research and technology transfer

The enhancement of rice research capability (research infrastructure and human resource) is essential to revitalize the Fiji rice industry. More rice researchers should be employed at Koroniva Research Station and Dreketi station. Training of rice researchers should be done frequently through international cooperation and partnership, particularly with the International Rice Research Institute and China. Priorities in the rice research program include the development of new rice varieties and integrated crop management technologies to increase rice productivity in a sustainable manner. New crop management techniques suitable for mechanization should be developed. The engagement of private sector and international development partners in rice R&D can be motivated.

In parallel with enhancement of research capacity, rice extension systems are also strengthened through improvement of operation facility and human resource to be able to transfer efficiently new technologies to farmers. The model of ToT, farmers field school (FFF) and farmers participatory research implemented in the on-going FAO supported project providing an effective approach to transfer technologies to farmers needs to be refined and scaled up.

Priorities in the rice research program in Fiji in 2016-2020:

- Breeding and development of new rice varieties (short duration, high yield, good grain quality, adapted to rained conditions) and selection of exotic varieties.
- Studies on integrated crop management, focusing on efficient management of nutrient and water.
- Adaptation test of improved production techniques like System of Rice Intensification (SRI), techniques for mechanized rice cultivation or model of organic rice production.
- Studies on diversification of rice-based cropping systems, focusing on intercropping and rotation cropping in rainfed areas.
- Studies on rice economy in Fiji (cost and return analysis, value chain analysis, etc.).

(7) Policy and institutional reforms

It is necessary to study in-depth the impact existing policies relating to the rice industry and recommendations of revised or new policies.

For the time being, some following points in rice policies may be considered:

- Solutions for the termination of lease of rice land in association with the removal of tenant farmers from rice farming.
- A long-term approach to support farmers in capability building to replace step by step the input subsidy systems in association with the promotion of commercial rice production and strengthening of the support through credit and insurance provision.
- Encouragement of the private sector, including foreign companies, public-private partnership (PPP) to invest in rice production, seed and inputs, processing and mechanization.
- Reforms of state-own milling factories, for example to convert to PPP to enhance resources for improvement in processing and market.
- Availability of credits to support both smallholder and commercial production.

- Thoughtful adjustment of rice import tax in balance of promoting domestic production and food security and avoiding the adverse effects on the rice consumers.

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In Fiji rice, is a major source of food and has contributed to the improvement of the livelihood of thousands of farmers relying on rice as a main source of income. Therefore, rice has multi-dimension roles as the foundations of food security, economic growth as well as social and political stability.

However, the Fiji rice industry increasingly weakened over the years as the rice area and production declined while the rice yield growth has been stagnant or marginal. Since the 1980s Fiji has had to import more than 80 percent of the total rice demanded annually.

The Government of Fiji was highly determined to revitalize its rice industry with the establishment the National Rice Taskforce in September 2004. Since then the Government has given supportive policies and incentives along with increased investment from public and private sector to promote the rice industry development. However, rice production continuously declined and the dependence on rice imports has not been alleviated.

This publication incorporates the findings and results of a mission which took place in September 2016 to review the progress of the rice industry in Fiji. It offers feasible options for promoting the development and revitalization of the rice industry which will assist food security by alleviating dependence on rice imports.

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