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FOOD SECURITY IN PAPUA NEW GUINEA

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ABSTRACT

The food security situation in Papua New Guinea (PNG) is discussed. PNG is a nation blessed with natural resources but continues to face development and environmental challenges with implications on food security. While the country may be secured in terms of food production and quantity, there are concerns on the nutritional aspects. Short term threats, aggravated by climate change and other challenges such as increasing food prices are major concerns. Lessons learnt on efforts to address threats and other challenges and some strategies identified by the National Agricultural Research Institute are discussed.

1. INTRODUCTION

Food security in many places around the globe is under threat, prompting renewed emphasis on developing strategies to enhance food security. With emerging challenges such as land degradation, increased climate variability and population growth, it is widely recognized that to achieve global, regional, national, and local food security, new approaches and strategies are required.

PNG is blessed with natural resources but has development and environmental challenges with implications on food security. Some challenges faced in PNG and strategies to enhance food security are discussed in this paper. The paper is organized into nine sections. Section 2 discusses the concepts of food security. In Section 3, a brief background on Papua New Guinea is provided to give a glimpse of the economic performance of the country and its reflection on food security. Section 4 discusses the food security situation in PNG, followed by discussions on the threats and current challenges to food security in Sections 5 and 6 respectively. In Section 7, efforts taken to address threats and challenges are discussed. Strategies for enhancing food security as identified by the National Agricultural Research Institute are discussed in Section 8, ending with the conclusion in Section 9.

2. DEFINITIONS

The Food and Agriculture Organization(FAO) defines food security as a situation where all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences, so that they are able to maintain an active and healthy life. At the household level, a household is considered food secure when its occupants do not live in hunger or fear of starvation, being able to access continuous supply of nutritious food.

Food security is not the same as food self sufficiency. Food self-sufficiency is attained when a country is able to meet consumption needs from own production rather than by buying or importing. However, a country may be self sufficient in locally produced food yet may not attain

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adequate food security. Similarly, a country may be food secure, but may not attain self sufficiency in all foods.

The five fundamental aspects of food security are availability, access, stability, nutritional status and preferences of food. These have been further classified into food adequacy (availability, access and utilization), vulnerability (stability and self reliance) and sustainability (long-term persistence of food security) (Igua, 2001).

Food security is a complex issue. It affects the core of human life and survival but cannot be pinned down to a particular subject alone. It is closely associated with, and impacted by, a wide range of agriculture-based factors including access and use of agricultural land, the level and quality of natural resources, the development and diffusion of agricultural technologies and the level of investment in agricultural sector development. Other important factors that can either enable or inhibit the achievement of food security include, institutional arrangements, rural infrastructure, social and demographic mobility, agricultural sector and macro-economic development, and policies (Igua, 2001).

3. THE PAPUA NEW GUINEA ECONOMY – FIRST GLANCE ON FOOD SECURITY SITUATION

3.1. Geography

Papua New Guinea (PNG) is the second largest island in the world. It is located in the tropics, and occupies the eastern half of the island of New Guinea. PNG's closest neighbors are Indonesia (to the West), Solomon Islands (to the East), Philippines (to the North), Guam (to the North East) and Australia (to the South) (Figure 1). PNG has a total land area of 470,000 square kilometers which is made of the mainland as well as some 600 large and small offshore islands. It has a harsh and rugged terrain with a significant part of the land unavailable for agriculture. Nearly two-third of its land area comprises a vast chain of overlapping mountain ranges, steep-sided valleys and turbulent rivers and streams. Swamp lands are predominant in the south-western part of the country.



Figure 1. Map of Papua New Guinea

Source: <http://www.bing.com/search?q=map+of+PNG>

3.2. Population

The current population of PNG is about 7 million and growing at a rate of 2.7 percent per year. PNG has 21 provinces of which around 40 percent of the population lives in the Highlands (six provinces) and 60 percent lives in the Lowlands. Most of the people live in scattered rural village communities and are dependent on subsistence farming supplemented by cash income activities centered around tree crops, food crops, livestock and other non-agricultural activities.

3.3. Economy

Papua New Guinea is a small economy in terms of both absolute and per capita output (Table 1). The economy is dual consisting of both a formal and an informal sector and engages in activities that are both subsistence and market-based. It is oriented towards the production of primary products (agriculture, forestry, fisheries, minerals and gas) as opposed to secondary (manufacturing) and tertiary (service) activities. It has an open policy that allows export of commodities from its rich resource base from which it largely depends on for income (Benediktsson 2002).

Table 1. National Output of PNG and Other Economies in 2009 (US\$)

	PNG	Australia	New Zealand	Japan
Gross Domestic Product (GDP) (Billion \$) ¹	8	1,014	117	5,069
Per Capita GDP ²	1179	46,290	27,029	40,055

Source: UNESCAP 2011

1. Measured in 1990 US dollars

2. Measured in 2000 PPP dollars

PNG's formal sector is small and provides limited employment for about 15 percent of the workforce in the mineral, manufacturing and public sectors, and in the service industries. The informal sector provides employment and sustenance for the other 85 percent of the nation's population. Agriculture, both subsistence and commercial, is the principal economic activity in terms of the occupational distribution of the labour force.

In the last few years, the economy was reported to improve in its performance (Table 2) however, this improvement is only happening at the macro-level and remains insufficient for broad-based economic growth. Whilst the national population is increasing rapidly each year, the country continues to struggle to provide adequate health, education, transport and public utilities infrastructures for its people. It also struggles with major issues related to law and order, land ownership and access, use of resources at all levels, and the threat of environmental degradation and unsustainable resource management. As such there is no measurable positive impact for the majority of the people, and especially not for those who live in rural areas and remote communities.

Table 2. National Output of PNG

	2000	2005	2009
Gross Domestic Product (GDP) (Billion \$) ¹	3	5	8
Per Capita GDP ²	651	798	1179

Source: UNESCAP 2011

1. Measured in 1990 US dollars

2. Measured in 2000 PPP dollars

As a result of this, PNG continues to trail behind on social status as shown by social indicators (Table 3). For instance, in 2009 PNG had a gross national income (GNI)² per capita of 2310 International Dollars³ which is less than one fifth of the average of the East Asia / Pacific Region (I\$15,743) and slightly higher than that of the Lower-Middle Income Countries (I\$2237), of which PNG is classified as a part of (World Bank, 1998).

Table 3. Comparative Social Indicators.

Indicator	PNG	East-Asia and Pacific Region	Lower-Middle Income Countries
Infant mortality (per 1,000 life births)	61	57	38
Life expectancy at birth (years)	58	69	68
Primary school enrolment (net enrolment ratio) ⁺	83	93	82 ⁺⁺
Human Development Index*	0.47	0.67	0.68**
GNI/Capita (2009 International Dollars)	2310	15,743	2237

Source: World Bank (1999 & 2009); ⁺UNESCO (2003/4); ⁺⁺the comparison is made against developing countries; *UNDP (2011); **World average

In addition, an estimated 60 percent of the population live in very poor conditions (Hanson et. al 2001), which is reflected in the low human development index (HDI) in PNG of 0.47, compared to the East-Asia and Pacific Region average of 0.67 and the world's average of 0.68. PNG also ranked on HDI at 153 out of 196 countries in the world (UNDP, 2011). Furthermore, life expectancy in PNG is low (58 years) compared to the average of the East-Asia and Pacific Region (69 years) and the Lower-Middle Income Countries (68 years). These social indicators show at a glance, that PNG has food security issues that need addressing.

4. THE FOOD SECURITY SITUATION IN PNG

PNG, like other developing countries, depends heavily on agriculture for most of its food and for the employment and cash income for a majority of its population. This dependence on agriculture is likely to continue for many years with agriculture continuing to play a vital role in the country's food security. According to experts on PNG agriculture, national food security in terms of food quantity, is generally good due to the fact that a high proportion of the population (>90%), being semi-subsistence smallholder farmers mainly in rural areas, are able to produce crops and livestock for their own consumption and to sell surplus for an income. Generally also,

² Gross National Income (GNI) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.

³ An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. GNI is converted to international dollars using purchasing power parity rates.

most people are able to access land for food production and to access cash income to buy food when subsistence supplies are low (Bourke 2001). Most people are also able to access a form of social-cultural network (including *wantok* system) in which food is shared and/or distributed amongst people in such networks. But although people generally may have access to food in terms of quantity, there are deficiencies in nutritional status of the population due to widespread problems with access to food of adequate quality and variety, for a nutritionally balanced diet. Crop-based energy foods are consumed in larger quantities compared to animal and/or plant protein-based food. Furthermore, most people and particularly those in rural areas are generally less educated about proper nutrition and are not able to maintain proper diets daily.

4.1. Sources of Food

PNG produces most of the food it consumes - about 83 and 76 percent respectively of food energy and protein, according to estimates by Bourke et al. (2009). The balance of the energy and protein food consumed comes from imports. Considering staple food of plant origin alone, PNG produces annually about 4.5 million tonnes (Table 4) (Bourke and Vlassak, 2004) and imports an average of 0.28 million tonnes each year (Table 5) (Bourke et al. 2009).

Table 4. Estimated production of staple food crops in 2000

Crop	Quantity (tonnes)
Sweet Potato	2,871,850
Banana	436,496
Cassava	271,895
Taro (various species)	460,049
Yam (various species)	272,713
Coconut	100,930
Sago	82,962
Others	20,600
Total	4,517,495

Note: others include potato, Queensland arrowroot and rice
Source: Bourke and Vlassak (2004)

Table 5. Average annual import of staple food

Commodity	Quantity (tonne)
Rice	152,000
Wheat	117,000
Vegetable oil	5,500
Fresh fruit & vegetables	6,000
Total	280,500

Source: Bourke et al. (2009)

4.2. Status of Locally Grown Food

There are different agro-ecological environments in PNG where a wide range of food crops can be grown. The main staple food crops grown in PNG are banana, coconut and root crops such as sweet potato, taro, yam and cassava (Table 4). Sago is an important staple crop especially in parts of the country that are seasonally flooded. Of the staple foods grown, sweet potato is the most important in terms of production and consumption and is widely grown throughout the country. In 2000, it was estimated that 81 percent of the rural village population of 4.3 million grew sweet potato as a dominant or sub-dominant staple crop. By 2004, the trend in sweet potato production increased (Bourke, 2004) and this trend is likely to increase further due to increases in rural population, land degradation and other issues. Land degradation results in soil being unable to support production of other staples such as banana and taro which require good soil and take longer to grow than sweet potato. The increased production of sweet potato will enable the availability of an energy-based food throughout the year for the increasing rural population.

In addition to staples, both tropical and temperate vegetables, including many different types of green vegetables, are grown respectively in the lowlands and high-altitude areas. Tropical fruits such as pineapple, pawpaw, guava, mango and so on are widely grown throughout the country and many such fruits can be found in backyards. These food crops are mostly grown for household consumption but surpluses are sold for cash income or given away to neighbors or relatives.

The most important animal foods consumed in PNG are pigs, chickens, cattle, fish and shell fish. Pig is the most important domestic animal raised for food. An estimated 1.8 million pigs are raised in villages compared to a relatively smaller numbers on commercial farms. An estimated 1.5 million chickens are raised in villages but production is usually low compared to commercial production. Cattle is estimated at around 80 000 heads with 80% commercially maintained and the remainder owned by villagers. Other animals also raised for meat but which are of less importance are duck, rabbit, sheep and goat. Marine animals including fish and shellfish, and 'bush animals' such as wild pig, small mammals and birds, are caught and consumed. The 'bush animals' are important sources of protein in remote locations (Bourke et al. 2009).

The yield of most of the staple crops and the productivity (feed efficiency and reproduction) of livestock raised in rural areas are quite low. Improving the productivity of the crops, livestock and the natural resources used in their production will greatly enhance their output.

4.3. Contribution of Improved Technologies to Food Production

The agriculture sector in PNG has a large untapped potential to assure food security, through increasing crop and livestock productivity. Moreover, if the productivity gains are large enough to significantly raise production, this will increase producers' incomes, while benefiting consumers through lower prices and providing opportunities for the labour force. Central to increasing the productivity and production of crop and livestock is the important role of research. International assessment of investment in research shows a 43% internal rate of return, while assessment in PNG from various research investments (including by donors) shows an internal rate of return of 30-35% (Young et al. 2004).

The PNG National Agricultural Research Institute (NARI) is mandated to undertake research on all aspects of agricultural development including crops, livestock, natural resources (such as soil and water), genetic resources, post harvest processes and down-stream processing, mechanization, markets and value chains, socio-cultural issues, policies, etc. In its short history of 15 years, NARI has released more than 20 technologies of various nature to its stakeholders. Among some of the technologies released to the farming communities are the African yam (*Dioscera rotundata*), NARI taros (hybrids from NARI research), NARI rice (adapted from IRRI varieties), low cost pig, poultry and in-land fish feeds (formulated from NARI research funded by ACIAR), clean pathogen tested sweet potato varieties (with promise of 4-fold increase in yield) and biological control agents of pests and weeds. These technologies should contribute both to increasing productivity and in reducing costs of production on farms, which in turn will enhance income of farmers.

4.4. Employment and Cash Income

About 15 percent of PNG's population is employed in the formal economy. These people live and work in urban and/or in mining areas. The other 85 percent of the population are engaged in the informal economy, of which a large percentage of them live in rural areas. Rural people have limited access to monetary income with few income generation opportunities available, apart from agriculture. Estimates from Bourke et al. (2009) based on 1990-1995 survey data showed that agriculture provides about 200 million PNG Kina (PGK), annually to rural households. Arabica coffee is the main income earner providing 33 percent of the total rural income and involving 44.5 percent of the total rural population. Fresh food crops sold on informal open markets provide 21.7 percent of income and involve 94 percent of total rural population. This is followed by cocoa at 10.9 percent, betel nut and betel pepper at 9.9 percent and copra at 8.1 percent involving 26.7, 35.2 and 16.6 percent of total rural population respectively. All other crops including oil palm provide less than 3 percent of income to the rural people. However, despite the large amount of money generated by agriculture, on per capita income basis, rural people earn very little. Estimates from the survey shows that about 82 percent of the rural population of 3.2 million, earns less than 150 PGK annually, while the other 12 percent earn between 151-300 PGK per year (Bourke et al. 2009). There is uneven distribution of income in the sector, as is in the economy.

Of all the agricultural products, fresh produce is the most important cash income source for many households even compared to Arabica coffee. With increasing population in urban areas and development sites such as the mining and oil fields, there is great potential for fresh produce marketing into those areas. However there is need to upgrade physical market places and facilities, produce new crops and better varieties to meet market demand, and provide better quality through improved post harvest handling and marketing practices.

Sources of income other than agriculture, include small retail stores or other outlets (selling processed and cooked food, and other products), transport businesses, trading as middlemen of betel nut and betel pepper, paid labour, remittances of money from relatives in urban areas, and royalties from mines, oil fields and forestry operations, etc (Bourke et al. 2009).

And although cash earning activities in PNG have increased in recent years, particularly in areas with reliable access to markets, the provision of roads and transport over the same period, has declined in many rural areas. The result of these changes are increasing transport and marketing

costs, lower returns to farmers and increasing prices to consumers. Such economic constraints greatly affect both the income available to farmers as well as the disposable income of consumers and consequently their nutritional conditions.

4.5. The Nutritional Status of PNG's Population

Most rural people and many low income urban dwellers, are food in-secured, being exposed to variable levels of food production and supply, poorly balanced diets, and lack of cash income and purchasing ability. While the availability of carbohydrate is moderate, the availability of quality protein, vitamins and minerals is grossly limiting for these people and especially for women and children, where the consumption of monotone and unbalanced diets has resulted in low health and nutritional status. This is reflected in low life expectancy rate in PNG (average of 57 years) compared to its Pacific neighbors', Solomon Islands (64 years) and Vanuatu (74 years).

In PNG, the average daily calorie availability is around 2,660 calories per person for both urban and rural areas. This is well above the minimum requirement of 2,000-2,200 calories. However, around 42 percent of the population in both rural and urban areas had been unable to meet a target food energy requirement of 2,000 calories per person per day (Gibson, 2001).

Whilst both the rural and urban areas face similar situations, the outcome reflects a significant difference in children's development. From a household survey in 1996, it was found that nearly 50 percent of rural children stunted while about 20 percent of children in urban areas display a similar characteristic. The difference in the development was suggested on significant differences in non-calorie inputs between the rural and urban sectors. Similarly, the survey found that adults in urban areas tend to have a higher body mass index than adults in rural areas whose diet consists mostly of crop-based energy food (Gibson, 2001).

The average daily protein availability in PNG is around 55 grams/day/adult equivalent. This is also well above the minimum requirement of 45 grams per day (Igua, 2001). However, there are differences in protein intake between the urban and the rural sector. The daily protein availability in urban area is almost 50 percent higher than in the rural areas. Similarly, urban diets have a higher energy density than do rural diets. The urban diets contain more meat, cereals, and fats and oils, than do rural diets (Gibson, 2001).

Malnutrition is an important nutritional problem in some areas of PNG. Malnutrition occurs in different forms. According to Marks (1992), protein energy malnutrition (PEM) is the most important form in PNG. It affects both adults and children but is more widespread amongst younger children aged 5 years and below, retarding their growth. The extent of the problem, however, varies from area to area in the country. PEM in children is caused mostly by food unavailability and low access to cash. Children with poor access to adequate nutritious food are stunted in their growth and display poor mental capacity. An important factor also is the neglect of children by women, due to the numerous role women play in the household. Poor access to nutritious food by mothers also results in high rate of infant mortality, low birth weight, and subsequently PEM when the children are not properly weaned (Marks, 1992). An important factor also is that, many rural people are illiterate and do not have access to information on proper nutrition which can also affects how they maintain their diet.

5. SHORT AND LONG TERM THREATS TO FOOD SECURITY

Sustainability of food production is becoming a major concern, owing to climate change, land and environment degradation, loss of genetic diversity and pest and disease attacks. Unimproved traditional farming practices, currently implemented in many rural areas, are low yielding.

Bourke (2001) listed a number of short term threats to food security for rural areas in PNG. These threats include:

- Frost causes damage to crops. While less severe damage occurs at lower altitudes (1500-2100 metres), those that are more serious occur at higher altitudes (≥ 2200 metres). Frost that is more threatening had been found to be associated with drought such as the ones in 1972, 1982 and 1997. This threat increases with climate change.
- Excessive soil moisture is an important cause of failure of many food crops, including sweet potato in the highlands, as observed by Bourke. Areas prone to high water table are mostly affected and can be particularly difficult during La Nina periods. This threat increases with climate change.
- Drought even if minor, has always led to some degree of crop failure. The most severe drought in recent times occurred in 1997 resulting in major shortages of food in many areas throughout the country. This threat increases with climate change.
- Variations in planting rates from one season to another result in food shortage, especially when villagers reduce their planting rate.
- Other local events such as clan fights and human disease epidemics. Bourke suggested that food shortages as a result of these threats are felt more at the local areas.

In addition to the above threats, there are those that are occurring frequently in many parts of PNG every year, such as floods and landslides. These disasters can result in 100 percent damage to food gardens and livestock. Pest and disease attacks are serious concern. With climate change, such attacks are bound to increase.

Bourke (2001) also suggested two main factors that are threats to the long-term food security in rural areas in PNG:

- Low cash income: As discussed in earlier sections, most people earn income from selling of agricultural products and other small processed or manufactured products or from remittance from relatives working in urban areas. When incomes are low, people's lives are at risk particularly those in the very remote areas with poor or nil access to services or transport infrastructure or who do not have relatives working elsewhere. They are the ones at great risk and suffer the most during periods of extreme stress such as drought.
- Land degradation: In some parts of the Highlands (e.g. Nembi Plateau in the Southern Highlands) and on smaller islands (about 140 islands with land area of between 1-100 square kilometers and population density of over 100 per square kilometer), land degradation is becoming a major risk factor as population density increases in those areas.

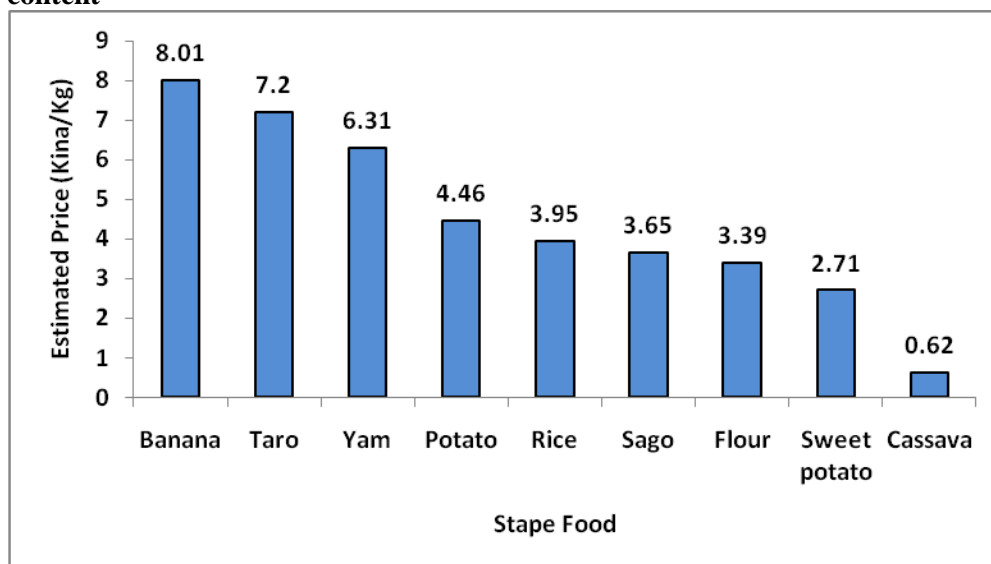
6. CURRENT CHALLENGES TO FOOD SECURITY

Currently, there are many challenges to food security in PNG. Some of the challenges include high food prices, poor infrastructure, social problems, negative impact of mining on agriculture, low investment in agriculture and women issues. These are discussed as follows.

6.1. High Prices of Food

As with the rest of the world, the continuous increase in food prices had been severely felt in PNG, especially by the low income households and more particularly, those dwelling in urban areas who depend a lot on imported and locally processed food as they do not have access to gardening space. Imported food such as rice, flour, milk and vegetable oil, and a number of locally processed and manufactured food, for example canned fish and meat, bread and sugar, etc continue to be expensive, reflecting high import costs including those of freight, other inputs and equipment required for use in food processing and manufacturing. Prices of locally grown staple food are also high in urban markets, particularly in Lae, Port Moresby, Madang and Rabaul. Estimates from Omot (2010) based on 2008 market survey data, shows that the average prices of some staple food in the Lae urban markets were much higher than imported food on energy content basis (refer Figure 1). For instance banana (plantain), taro, yam and potato were found to be expensive compared to imported rice and flour. Banana cost two times more than rice and flour. Anecdotal evidence shows that the prices of both the local and imported staple food have increased further since 2008. Sweet potato and cassava, however, are competitively priced against the other staples in markets throughout the country. Current prices of a wide range of vegetables and fruit sold in urban markets are high compared to ten to fifteen years ago.

Figure 1. Estimated price (K/Kg) of staple food in Lae in 2008, based on food energy content



Source: Omot, 2010, Survey

In the remote areas of most provinces, prices of many imported items are even higher than in the cities because of transport costs and a lack of competition (Bourke et al. 2009).

For locally produced food, a number of factors were identified as contributing to high food prices. Factors directly related to the production and marketing of local crop and animal food include: limited access to land for production; land shortages for food production due to increased cash cropping and population increases; limited assistance to farmers to expand production; irregular supply of food; negative effect of climate change on agricultural yields and food production; crop varieties susceptible to damage during storage and transportation; high costs of livestock feed; high costs of imported inputs for production; post harvest losses during

transportation to market; lack of ware houses for food storage; fragmented markets with little or no vertical and horizontal coordination; poor access by farmers to markets; high costs of trade, transport and communication due to poor infrastructure; lack of safe market environment for sellers and buyers and high marketing costs (due to freight, low middlemen involvement and hidden costs, loss of quality and product deterioration). Unless adequately addressed, prices will continue to remain high or increase further in the future.

6.2. Poor Infrastructure

Under investment, sabotage and natural disasters such as heavy rainfall, flood and landslide have been the cause of deteriorating states of national infrastructure such as roads and bridges, impeding the delivery of quantity and quality food on time to urban areas. Much of the food production occurs in rural areas and must be transported into urban markets at which actual shipment depends on availability of transport. The most common form of transport is road transport. The supply and marketing of food by smallholder farmers is in most parts, uncoordinated. Suppliers arrange their own transport by negotiating with truck owners, or flagging down vehicles. Actual shipment may occur from just a few hours after harvest or may occur after 1-5 days depending on availability of transport. Delayed shipment due to road and bridge impasses can also occur causing late delivery of food. Most of the transport used is unsuitable for fresh produce transportation which for long distant marketing, can result in significant losses of 30-50 percent (Chang and Spriggs, 2007).

A few supply chains are more coordinated, which are operated by established small-scale middlemen. These suppliers use chiller containers which maintain the quality of food during transportation. They are also able to supply large quantities especially of more perishable fresh food unlike the majority of the other suppliers who may not be able to source enough supplies to fill a container. A few suppliers also freight highly perishable vegetables by air, usually from the highlands to Port Moresby at high costs, which are then passed on to consumers at high prices.

While the transportation issue is a major concern, an equally great concern is the lack of appropriate storage facility at both collection sites in production areas and at delivery sites in urban areas, particularly at urban and peri-urban open markets where the majority of the urban dwellers shop for fresh food. At collection sites, in most cases, there is no storage sheds or other shelters so fresh food is kept in the open in rain and sun (maybe with a canvas thrown over) whilst waiting for transportation. Making matters worse, fresh produce in most cases are packed in polypropelene and other similar bags, which are cheaper to buy and recycled than other appropriate package types. These bags encourage 'sweating' and pose greater risk to quality deterioration. The bags are used mainly for their capability to hold in food but are unpractical for maintain quality. The manner in which bags are piled on top of each other during waiting period, and on top of the trucks during transportation adds further to quality deterioration. At urban and peri-urban open markets, there are no storage facilities to store fresh food so quality is affected again. In addition, there are shortage of market shelters and benches so a lot of fresh produce is sold in the open air. Fresh food sold to wholesalers and supermarkets are usually stored well until they are sold but the shelf life may still be affected due to poor packaging and handling (especially of uncoordinated farmers) during transportation.

6.3. Social Issues including Law and Order

Tribal fights and ethnic clashes usually affect the production of and pose threat to the supply of food. Theft in gardens and during transportation, also discourage large plantings of food garden. Most marketers of fresh food to urban markets are also not regular suppliers, as evidenced by recent research on sweet potato suppliers (Omot, 2010). Benediktsson (2002) also found that sellers, especially males, often lose interest in commercial growing after they sold large quantities of vegetables. In addition, he found that sellers (both men and women) show a lack of dedication to market gardening after a market trip because of the need to meet customary and social obligations, and also that for a while, their subsistence needs can be met by home gardening. This affects the supply of food to urban areas.

Women are major supplies of food to local markets but may not participate freely because of law and order problems while en-route to markets or back to villages. Such problems include hold-ups, theft and sexual harassment by men. Fewer women participate in the more profitable long-distance marketing because of the above reasons. This greatly limits their access to income.

6.4. Low Perception of Agriculture's Contribution to Development

When there is low perception of the importance of agriculture and its potential contribution to development, investment in the sector will be low. According to the World Development Report 2008 (WRD 2008), 10 percent of Agricultural GDP is needed if agriculture is to progress into a transformed country. However, less than 5 percent of Agricultural GDP (about Kina 20 million) is currently invested in agriculture in PNG. Ideally Kina 400 million (of Kina 4 billion Ag. GDP) is needed to reach the 10 percent indicated by WDR 2008 and which in turn needs to be invested in entire systems to achieve maximum benefit and impact. However, despite its importance to the majority of the population, the sector continues to struggle and remains under-developed.

Agriculture has great potential to contribute to food security in the nation through improved productivity of crops, livestock and natural resources and supported by enabling environment of infrastructure, facilities, policies, etc. Currently the productivity level of the natural resource base is low and degrading further, as there is a low rate of replenishment under existing systems. With the onset of climate change (changing temperature, rainfall and hot/cold day patterns), there are threats of increased attacks from existing and potential pests and diseases on crops and livestock. Unless the sector is given priority, the threats will become a reality.

In addition, inherently resource poor areas, particularly those that are difficult, for example atolls, are also largely neglected with little public expenditure heading that way. Investment in research, and dissemination of improved technologies and innovations could greatly improve agriculture production in those areas. Also there are unexplored rich and unique genetic diversity including under-utilised domestic resources such as feeds and indigenous nuts/fruits/livestock, etc, in PNG which could greatly contribute to the productivity and performance of current domesticated crops and livestock and contribute to food security. An important area that requires further consideration is value adding and preservation, especially of perishable crops and crops that are high weight/volume to value such as root and tuber staples. Other important areas relate to linking farmers to markets domestically and to international markets such as through merging enterprises or niche markets for export of organic produce, bio-

pesticides, pulses, vanilla, honey, etc (Ghodake, 2011)⁴.. These should be viewed as important channels for development, bringing people out of poverty.

6.5. Lack of Support to Women who are Major Producers of Food

An important issue recognized globally in academic and scientific arena, in relation to food security is the lack of attention paid to women as farmers, producers and farm workers (both wage and non-wage) and their role in reducing hunger and increasing rural incomes. Women not only produce and process agricultural products but they are also responsible for much of the trade in these and other goods. Despite their contributions to food security, women tend to be invisible actors in development. Their contributions are often concealed usually due to some social and gender bias. Their work often is not recorded in statistics or mentioned in reports (Mehra and Rojas, 2008). As a result, their contribution is poorly understood and often underestimated.

In PNG, women make up almost 50 percent of the population. Nearly 90 percent of them are engaged in agriculture, fisheries and forestry related activities. They produce the bulk of the nation's food without their contributions recognized. But most often they face challenges in food production and trade. Social constraints place barriers around women's access to scientific and technological information. Lack of collateral denies them access to agricultural credit while culture or traditions accord ownership of land and other resources to men. To enhance the contribution of women in food production and supply and to ensure food security at household levels, the issues facing women in agriculture need to be adequately addressed.

Nevertheless, in spite of social, political and economic constraints, women have proved extremely resourceful and hardworking in their attempt to ensure household and national food security. Some women with access to adequate transport and markets, particularly those in and around urban areas, have diversified their income source by streaming into floriculture, downstream processing of agricultural products and cottage industries. Women groups have also been formed and now operate in farm apiculture, inland aquaculture, and vegetable production and marketing. These efforts need to be recognized and appropriately supported.

7. EFFORTS TAKEN TO ADDRESS ABOVE THREATS AND CHALLENGES, AND LESSONS LEARNT

- High food prices: A food security conference was held in November 2011 in Port Moresby to discuss and address issues on high food prices in PNG. A number of factors were identified as contributing to high food prices and need to be adequately addressed. NARI is undertaking research to address those issues related to crop and livestock productivity, production, natural resources, some aspects of post harvest and value chain analysis with funding support from Australian Centre for International Agricultural Research and the PNG Government.
- Poor infrastructure: The government has increased its budget to improve infrastructure, particularly roads, however implementation is slow. There are no developments in market infrastructure.
- Social issues: Some of the issues tie in with culture and is difficult to address in short term, for example, abandoning market gardens to meet social obligations. Social problems relating to law and order still thrive despite government efforts to maintain them at lower levels. It

⁴ Power point presentations at various meetings during 2011

requires support of communities and their leaders to adequately address these. This is happening in some communities.

- Low perceptions on Agriculture: There was a decline in agricultural research funding in 2010-2011 both in absolute terms and compared to investments in other sectors. The National Agricultural Research Organizations (comprising of NARI, Cocoa and Coconut Institute, Coffee Research Institute, Oil Palm Research Association, Oil Palm Industry Corporation and the Fresh Produce Development Agency) launched a forum in September 2011. The aim of the forum is to effectively bring the concerns of farmers to decision makers' attention and to create more awareness on the importance of the sector so that the government increases its support for the sustainability of the sector. The government must commit to allocating a percentage of the revenue from the mineral sector for the development of the agriculture sector for the long run.
- Women's issues: A number of activities had been implemented targeting women. Some projects currently developed by ACIAR and NARI aim to build capacities of women (business skills, marketing, networking etc) and strengthen their operations. The PNG Women in Agriculture Development Foundation (PNGWiADF) was established in 2007 and launched in 2008. PNGWiADF partners with NARI and other agriculture organizations. The challenge is to effectively network so that trainings and other benefits filter down the line to women in the districts and villages.
- Short-term threats: Threats such as frost, excessive soil moisture, and drought are becoming important concerns with the onset of climate change. NARI is implementing a project funded by the European Union and another by the PNG Government to address these threats. These projects are implemented in collaboration with a number of key organizations and farming communities.
- Long-term threats: Land degradation is a major concern as population increases in vulnerable and isolated areas. NARI is doing some work with affected communities to manage productivity of their natural resources and farm outputs. CCI, CRI, OPRA and OPIC are also addressing these issues with their targeted crops and farmers.

The main lessons learnt from attempts to address challenges and threats to food security are:

- There has been various high level meetings and a number of strategies developed by the government and various organizations to address the challenges facing the agriculture sector however, implementation of the strategies had been very poor due to low funding, corruption, inefficiencies of organizations, poorly staffed organizations, inadequate quality staff, etc.
- In the past, there was little alignment of organizations strategic plans to the government's vision and plans, hence the government could not see how those plans would help it achieve its national goals of an healthy, wealthy, happy society. The last few years has seen organizations strategically planning and linking their plans to the government's so hopefully, the government should provide adequate support to the sector.
- Mis-use and mismanagement of resources at all levels is a major challenge. Very strict rules and guidelines must be enforced to ensure transparency and accountability in use of all resources, so that funds are properly used for the development of the sector. This will open up opportunities for people in rural and remote communities.
- With the on-set of climate change, the threats facing farming and rural communities will be further aggravated so a collaborative effort by the government and concerned organizations is required to assist communities to prepare for such threats.

- A collaborative effort is required in the development and dissemination of improved agricultural technologies and trainings to farming and rural communities. Research organizations need to strategically plan and or identify new and existing networks in the communities to effectively work with, to ensure greater impact at farm levels.
- The NARS organizations had developed their strategic plans for the next 10-15 years and aligned these to the government's vision and plans. Some of the strategies developed by NARI in consultation with a wide stakeholders (researchers from different NARS organizations, government and NGO extension people, provincial and district government officers, DAL representatives and farmers) are presented below.

8. STRATEGIES FOR FOOD SECURITY

NARI as the organisation tasked to look after food crops, has undergone extensive planning and had come up with some of the strategies listed below, aiming to enhance productivity among smallholders that will contribute to food security. Other organisations in the sector like Cocoa and Coconut Institute and Coffee Industry Corporation, does important work to enhance productivity of the cash crops, which also contributes to food security through income generation. NARI recognizes that for research outputs to have greater impact at farming communities, an integrated and collective actions of all stakeholders is required to improve technologies, policies and institutions involved in production, processing and marketing to contribute to and enhancing of food security.

Below are lists of strategies, categorized into 3 groups, which can be considered for ensuring and enhancing food security. Strategies related to improving agricultural systems can include:

- Supply of suitable planting materials, breeding stock and other farm inputs to smallholder farmers
- Improving marketing systems for priority crop and livestock enterprises
- Preparing smallholder farming communities to better prepare to cope with abiotic stresses due to seasonal weather patterns, climate change and natural disasters
- Empowering farmers to sustainably manage biotic agro-ecosystem threats
- Developing and supplying of suitable small farm machinery
- Improving and encouraging integrated farming systems of crops, livestock, aquaculture
- Increasing investment in agriculture sector including agricultural research and development

Strategies related to enhancing an enabling environment for farmers can include:

- Improving marketing opportunities for agricultural commodities
- Improving institutional arrangements (for credits and other required services) for farmers
- Recognizing and supporting the role of women in agricultural production and marketing
- Identifying and developing income opportunities for farmers
- Improving the ability of farming communities to mobilize land for agricultural development

Strategies related to improving infrastructure can include:

- Improving socio-economic services such as health clinics and banking facilities for rural farming communities
- Development of consolidating depots and storage facilities in appropriate points of collection and disbursement, for vegetables

- Improvement of road infrastructure including feeder roads and bridges in rural communities

9. CONCLUSION

Emerging challenges such as land degradation, increased climate variability and population growth had challenged food security in many countries and it is widely recognized that to achieve global, regional, national, and local food security, new approaches and strategies are required. Food security must be considered in its entirety in terms of availability, access, stability, nutritional status and preferences of food. In PNG, most people have access to food, in terms of quantity (that is food is availability or there is cash to purchase), however, in terms of nutritional status, there are concerns of poorly balanced diets, un-nutritious food, and poor health. People may not have the food they prefer or need for a balanced diet because it may be difficult to access, whether physically or economically.

In terms of stability, PNG has its own challenges. There are short and long term threats such as climatic (including climate change threats), environmental, and pest/diseases attacks on food production. Other challenges include high food prices, poor infrastructure, social issues, low perceptions on contribution of agriculture to development and challenges faced by women as major producers of food.

Attempts had been made to address challenges and threats to food security in PNG, however, these are happening in some areas only while progress and development in other areas are slow. For instance, the government has increased funding for road improvements but the progress is slow everywhere and no actual work implemented in some areas hence further delaying effective participation of the people in activities that will enhance food security. Challenges related to crop and livestock production are addressed by NARI.

Mis-use and mismanagement of resources at all levels is a major challenge. Very strict rules and guidelines must be enforced to ensure transparency and accountability in use of all resources, so that funds are properly used for the development of the sector. This will open up opportunities for people in rural and remote communities.

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