

Crop production of Northern Mindanao, Philippines: Its contribution to the Regional Economy and Food Security

G.M. Dejarne–Calalang^{1*}, L. Bock² & G. Colinet²

Keywords: Northern Mindanao- Crop production- Economic contribution, Food security, Crop export- Philippines

Summary

This paper presents the contribution of primary agricultural crops produced in Northern Mindanao to its economy and food security of people with the situational analysis and insights of the authors. Rice as the staple food of most Filipinos is insufficient in quantity produced. Corn production is more than enough for the total regional demand. White corn is preferred as secondary staple food, however the corn industry emphasizes yellow corn production and the bulk of this goes to raw materials for livestock and poultry feeds. Coconut, sugar, pineapple and bananas significantly contribute to agricultural exports. Coconut is processed before exporting which can offer employment in the rural areas. Sugarcane, pineapple and bananas have created a change in the land use and hence compete with rice and corn. Northern Mindanao is one of the leading producers of tomatoes, carrots and potatoes, yet farmers have encountered deterring factors in attaining potential income from these products. Although Bukidnon province is the top agricultural producer in the region, poverty in the area remains high.

Résumé

Production végétale à Mindanao nord, Philippines: contribution à l'économie régionale et à la sécurité alimentaire

Cet article présente l'état de la situation et l'éclairage des auteurs quant à la contribution des principales plantes cultivées à l'économie et à la sécurité alimentaire de la population dans la région nord de Mindanao. Le riz qui constitue l'aliment principal de la plupart des Philippins n'est pas produit en quantité suffisante. La production de maïs est excédentaire par rapport à la demande régionale. Le maïs blanc est préféré comme second aliment principal, bien que l'industrie encourage la production de maïs jaune; la majeure partie de ce dernier servant à l'alimentation du bétail et de la volaille. Les plantations de cocotiers, de canne à sucre, d'ananas, et de bananier contribuent significativement aux exportations agricoles. La récolte des noix de coco est transformée avant exportation; ce qui offre de l'emploi en milieu rural. La canne à sucre, l'ananas et la banane ont provoqué un changement dans l'utilisation des terres et entrent désormais en compétition avec le riz et le maïs. Mindanao nord est une des plus importantes régions pour la production de tomates, de carottes et de pommes de terre, même si les agriculteurs rencontrent des difficultés pour atteindre les revenus potentiels de ces «spéculations». Bien que le Bukidnon soit la province la plus importante de la région en matière de production, la pauvreté y reste élevée.

^{1*}Xavier University, College of Agriculture, Cagayan de Oro City, Philippines.

²University of Liege-Gembloux Agro-Bio Tech, Gembloux, Belgium.

Corresponding author: Email: gcalalang@xu.edu.ph

Received on 5.03.14 and accepted for publication on 9.07.14

Introduction

The colonization of the Philippines by foreign powers, until the country was granted its independence by the United States in 1946, had shaped the social and political system of the nation and consequently influenced the use and management of its natural resources including land. This had resulted in unequal distribution of the country's wealth among Filipinos and until now the disparity of land ownership prevails. Landlordism characterized the country's land ownership and in this feudalistic system the farmers working on landlord lands became tenants and their children after them generation after generation (14). The opening up of large areas in Mindanao through logging and/or agriculture paved the way for migrants to establish resettlements and cultivate the soil. In Bukidnon, this forced the integration of the natives into the dominant community. Those who followed a different path had to move deeper into the forests and the areas they vacated were occupied and titled under the names of the settlers (10).

The country's agriculture industry was made visible to the outside world during the Spanish colonization when Filipino farmers produced agricultural crops like tobacco (*Nicotiana tabacum*, Linn.), abaca (*Musa textilis*, Nee), coffee (*Coffea* spp.) and spices for export (14). Agriculture, fishery and forestry sector employ most of the rural workforce. In 2006, agriculture employment in Northern Mindanao was estimated to be 47% of the region's total workforce (17) and in 2012 it still absorbed 43% of the total employment (1). Recent employment has shifted towards services. Modernization of the Philippine agriculture had started for a long time, however the food security of people remains an important issue. From 2006 to 2012, poverty incidence among Filipino families remained unchanged (18). Since agriculture is dependent on environmental and climatic factors, subsistence farmers are the most vulnerable to adversities brought about by environmental degradation and climate anomalies. This is because these farmers have small landholdings, are cultivating marginal lands, lack technical knowledge, and have meager or no financial support.

This paper presents the status of production of rice (*Oryza sativa*, Linn.), corn (*Zea mays*, Linn.), coconut (*Cocos nucifera*, Linn.), pineapple (*Ananas comosus*, Linn. Merr.), bananas (*Musa sapientum*, Linn.), commercial vegetables and root crops and their contribution to the regional economy and food security in Northern Mindanao. It also presents the strengths and potentials of its agricultural crop production and the underlying issues and concerns. Information gathered on this topic depicts two opposing scenarios. First, crop production significantly contributes to the flourishing economy of Northern Mindanao. Second, although agriculture is a major contributor to the rising economy, poverty is still prevalent and thus threatens the people's security on food. These two antagonizing situations of the Northern Mindanao economy have to be reconciled. The "trickle down" effects of economic gains should be felt by the majority for regional development to be effective. Balanced information is needed in order to draw a clear picture of how crop production has supported the household economy of Northern Mindanao and to find a common ground for better recommendations in development planning.

Methodology

Sources of information in this paper were taken from on line journals, reviews, compilation of agricultural research reports for Northern Mindanao, graduate program theses, reports from local and national government offices, and government websites. This also includes results of crop yield investigations and soil fertility assessments in the highlands of Bukidnon conducted by the authors.

Profile of Northern Mindanao

Northern Mindanao occupies a land area of 20,186 km² which is the fifth biggest area among the 17 regions of the Philippines. Figure 1 shows the map of Mindanao, Northern Mindanao and Philippines.

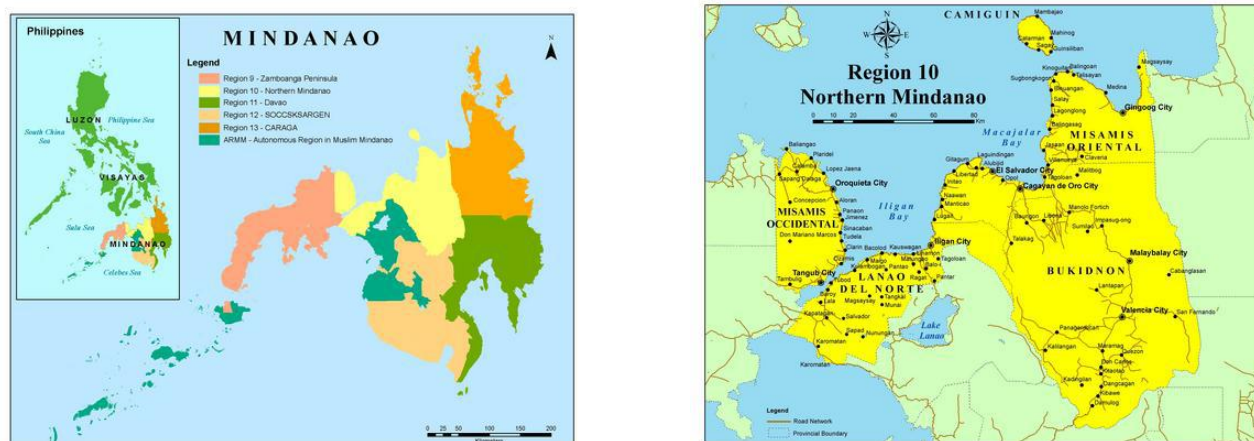


Figure 1: Map of Northern Mindanao and Mindanao, Philippines inset (Courtesy: Mark Alexis O. Sabines, XUCA, Geomatics, Philippines).

The Regional Population

Based on the 2010 census, Northern Mindanao has a population of 4.297million, with an average household size of 4.7 and a population density of 210 persons per square kilometer (19). There are 1,137.197 indigenous peoples living in Northern Mindanao (27) and Bukidnon Province is the home of the seven tribes.

The Political Structure

The region is politically subdivided into five provinces namely: (i) Bukidnon with Malaybalay and Valencia as its two cities, (ii) Misamis Oriental with Cagayan de Oro City as the regional capital, El Salvador City and Gingoog City, (iii) Misamis Occidental with its two cities, Tangub and Oroquieta, (iv) the Island Province of Camiguin, (v) and Lanao del Norte, the province that was added to the region in 2001. It has 12 congressional districts, 84 municipalities and 2,020 barangays. The congressional districts are represented by a Congressman/woman to the country's House of Representatives. The province is headed by a Governor, the municipality by a Mayor and the barangay, the smallest government unit, by a Barangay Captain. For indigenous communities, two leaders are recognized, the Barangay Captain, who is voted by his/her constituents and recognized by the Philippine government to attend to the political affairs, and the Datu, whom by virtue of succession, takes charge of the community's cultural affairs.

The Regional Economy of Northern Mindanao

The Gross Regional Domestic Product (GRDP) of Northern Mindanao was PhP367.1 billion (€6,107 billion at currency conversion rate of PhP60.11: €1:00) putting it as the second largest economy in Mindanao and ranks seventh of the 17 regions in the Philippines (16). Figure 2 shows the distribution of GRDP. Agriculture and its related enterprises are the second largest contributor to the expansion of the regional economy. The regional poverty incidence among population and families are 43.1% and 35.6%, respectively (18). Bukidnon is the food basket of the region but has the highest per capita poverty incidence among population and families which are 50.8% and 43.3% respectively (18).

Major crops of the region

The Philippine government's agricultural programs for the region are for rice, corn, high value crops, and livestock. Large portions of land dedicated to agriculture are used to grow coconut, bananas, pineapple, corn and rice.

Rice, the staple food

Paddy is a traditional crop and the staple food of most Filipinos. The 2012 national production was 18.033 million tons with a sufficiency level of 94% (1). Importation of rice was already noted in the latter part of the nineteenth century during the rapid development of abaca, tobacco and coconut for the international market (24) and at present the country is importing about 1 million tons from other Asian countries (1).

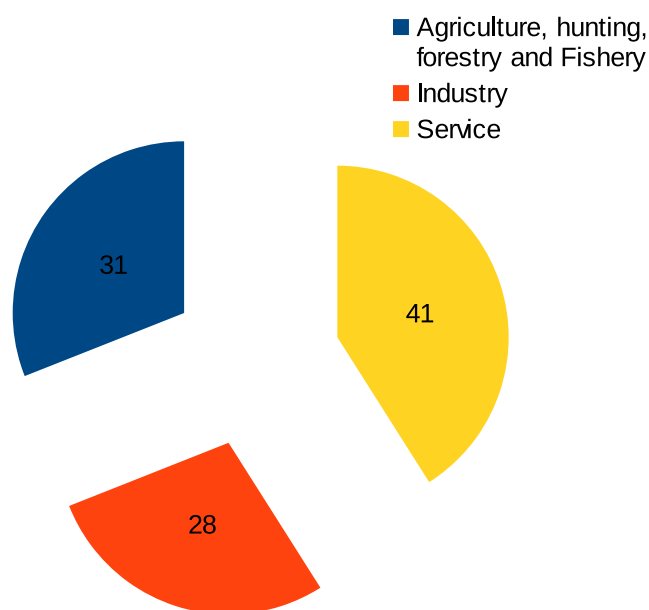


Figure 2: Per cent GRDP distribution of the three major sectors of Northern Mindanao at current prices in 2011.

Source: 16

Its contribution to the regional economy

The 2012 rice production data of the region revealed that the regional area planted to rice was 154,712 ha with an overall production of 637,348 t at a farm gate price of PhP16.78 (€0,28) per kilogram (1). Figure 3 presents the production trend from 1994 to 2012. Bukidnon is the highest producer with production value in 2012 at PhP6.291 billion (€0,105 billion). Although production is increasing over the years, rice supply does not satisfy the regional demand.

Production risk management

Farmers insure their crops to secure their investments against losses due to natural calamities and pest infestations. Typhoons, floods, droughts, rat and insect infestations are the causes of crop production losses. The main insect pests and diseases that are infesting on paddy fields are stem borers, army worms, tungro virus, rice blast, and bacterial leaf blight. The 2000 to 2010 Bukidnon data shows that a total of 23,583 hectares of rice lands of 16,105 farmers were covered with a Total Sum Insured (TSI) of PhP369.766 million (€6,151 million) (21). The indemnity claims of aforementioned insurance coverage for these years amounted to PhP17.329 million (€0,288 million) for

4,913 hectares and the average payment received per hectare was PhP3,527 (€58,68) (21). Paddy rice production cost is PhP10.04 (€0,17) per kilogram and therefore at a yield of 4.12 t ha⁻¹, the estimated total production cost per hectare is PhP41,368 (€688,20) (1). Since Northern Mindanao is frequently hit by calamities, compensation for the damage is generally not enough to cover the production cost and the farmers have to incur financial losses.

Rice contribution to food security

The per capita utilization of rice in the country is 391 g day⁻¹(1) and therefore a family of six consumes 2.35 kg day⁻¹. The retail prices of milled rice ranges from PhP33.00 (€0,55) to PhP45.00 (€0,75) per kilogram. A worker in Northern Mindanao receives an average minimum wage of PhP289.00 (€4,81) daily (20) and therefore his/her family of six spends at least PhP78.00 (€1,30) daily for rice alone. The scenario in the rural areas is worse because the availability of jobs is seasonal and thus the workers'

income is low. Agricultural workers are hired during peak seasons (planting and harvesting periods) only and if more labor is available the wage is brought down below the minimum legal rate. At a yield of 4.12 t ha⁻¹, rice sufficiency level in Northern Mindanao is only at 71.8% (16). Northern Mindanao outsources rice from other regions in the Philippines or from abroad. Among the reasons of rice production decline is the shifting of land use to banana, pineapple and sugarcane by multinational agro industries (17). As the country does not have a unified land use policy the increasing exportation of fruits and cane sugar may have triggered the conversion of rice lands into plantations. Moreover, rice production has been abandoned in some areas where irrigation facilities are no longer working due to poor maintenance. With high production cost that makes rice farming less profitable, the farmers may opt to sell or offer their lands to rent. Conversion of rice lands into housing and industrial development uses is observed in many parts of the Philippines.

Figure 3
Northern Mindanao annual rice production volume from 1994 to 2012.

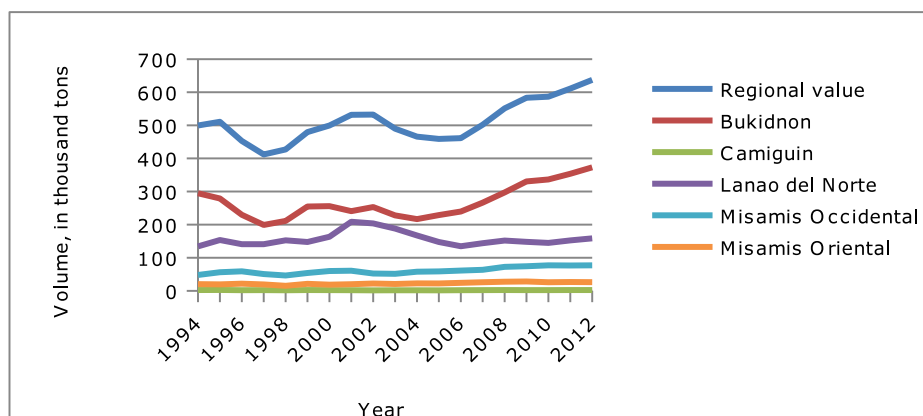


Table 1

| Northern Mindanao and its Provinces | Volume (x1000 t) | | | Yield (t/ha ⁻¹) | | Sufficiency Level (%) |
|-------------------------------------|------------------|-------|--------|-----------------------------|-------|-----------------------|
| | Yellow | White | Total | Yellow | White | |
| Northern Mindanao | 864,8 | 363,9 | 1228,7 | 4,72 | 1,88 | 142,9 |
| Bukidnon | 780,3 | 65,2 | 845,5 | 4,74 | 2,37 | 124,6 |
| Camiguin | 0,1 | 0,5 | 0,6 | 1,67 | 1,25 | 7,5 |
| Lanao del Norte | 18,1 | 205,8 | 223,9 | 3,77 | 2,02 | 109,6 |
| Misamis Occidental | 3,9 | 45,5 | 49,4 | 3,90 | 1,81 | 120,9 |
| Misamis Oriental | 62,4 | 46,9 | 109,3 | 4,83 | 1,22 | 396,9 |

Source: 1

Corn, the largest contributor to the regional agricultural economy

In 2012, corn production contributes PhP94 billion (€1,564 billion) to the Philippine economy and Northern Mindanao shares 15.7% (1). White corn is preferred by Filipinos as the secondary staple food and yellow corn is the main ingredient of poultry and livestock feeds and as raw material for manufacturing starch syrup, oil and other starch derivatives.

The regional corn production

Table 1 shows the 2012 corn production volume, yield and sufficiency level of Northern Mindanao and its provinces. Bukidnon ranks first in production of white and yellow corn followed by Lanao del Norte. Yellow corn production is significantly higher than white corn because Bukidnon that contributes 70% to the regional production emphasizes the yellow variety. Generally, corn supply satisfies the demand of each province except for Camiguin which is a small island.

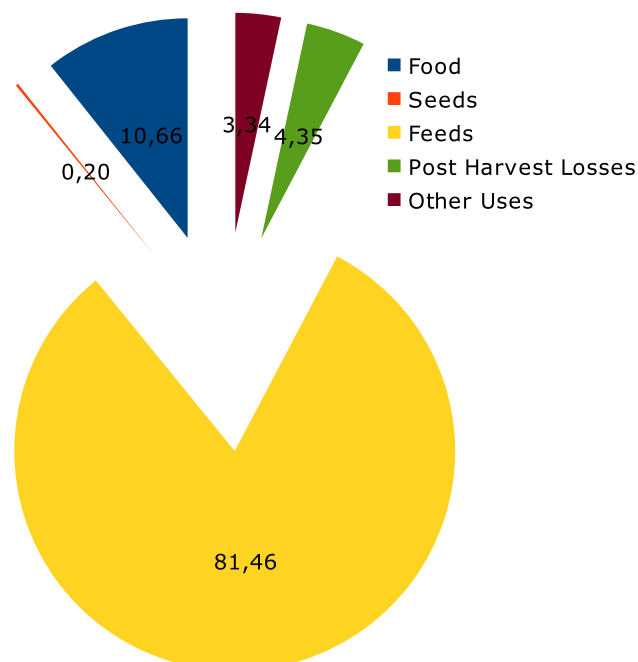


Figure 4: Uses of produced corn from Northern Mindanao in 2011.

Source: 16

Misamis Oriental produces almost four times its demand although it is not the top producing province in the region. Although Bukidnon takes the biggest share of production in the region, its sufficiency level is only 25% over what is required. Corn demand is high in the province because it is the location where most of the poultry and livestock industries of the region which use the bulk of corn harvest are found there (Figure 4). The 2012 annual national average yield value for white corn is 1.65 t ha⁻¹ while Bukidnon has 1.88 t ha⁻¹ (1). The average production cost of white corn is PhP11.31 (€0,19) per kilogram while of yellow corn is PhP7.68 (€0, 13) per kilogram (1).

A study conducted in Dalwangan, (Bukidnon province) on open pollinated white corn variety from 1997 to 1999 revealed that using a combination of organic and inorganic fertilizers the highest yield was 5.07 t ha⁻¹ during the wet season (12). Yield measurement studies conducted by the authors on the volcanic foot slope of Mt. Kalatungan, Miarrayon, Talakag, Bukidnon found out that the average yield of native white corn in a harvest is 3.61 t ha⁻¹, which is higher than the average provincial yield. Farmers in Miarrayon plant corn for home consumption and as rotation crop for carrots and potatoes. Crop maintenance does not include fertilizer application. The nutrients that were previously applied for carrots or potatoes may be slowly released from the soil in available forms hence corn as the succeeding crop will utilize them. Miarrayon soils have been intensively cultivated for more than 50 years however crops in the area produced competitive yields. Therefore the regional harvest value indicates that corn production has not attained its potential yield.

There is disproportionate allocation of area between yellow and white corn in Bukidnon. Yellow corn occupied 85.66% of the total provincial area intended for corn while white corn is at 14.34% (16). It is observed that yellow corn is planted in areas along steep slopes in Cabanglasan, Malaybalay and Talakag, Bukidnon. White corn which is most preferred by corn-eating Filipinos can be a counterbalance to rice insufficiency. However, particularly in Bukidnon, the yellow corn occupies almost all of the areas planted to corn putting the

white variety at a less significant level.

There is need to examine carefully the economics of white and yellow corn production to come up with a sound decision on which of the two varieties shall be popularized. This should consider the aspects on crop suitability to soil characteristics, crop management, labor requirement, fertilizers and pesticides (type and quantity), cost of seed procurement, quality of product (for food and feed use), and the environmental impacts of production. The high use of agricultural inputs for yellow corn production and the planting of these shallow rooted crops on fragile slopes have to be checked. The production and use of white corn as food crop should be emphasized to compensate the demands in areas where rice is insufficient.

Production losses and risk management

Corn production losses are due to natural disasters, pest infestations and post-harvest inefficiencies. Farmers insure the crops against typhoon, flood, drought, pests and diseases. In Bukidnon alone, the TSI from 2000 to 2010 was PhP281.662 million (€4,686 million) with total area coverage of 27,448 hectares and the total indemnity paid was PhP32.358 million (€0.538 million) to 12,976 farms (21). In 2010, the average claims per hectare was PhP2,682 (€44,62) (21) which is only a small fraction of the total production costs per hectare of PhP18,722 (€311, 46) for white corn and PhP32,930 (€547, 83) for yellow corn (1).

Postharvest losses also affect the economic returns of corn production. Reasons cited for post-harvest losses were bad weather conditions, labor shortage, inefficiency of machine used, improper postharvest practices and lack of awareness on the part of the workers or handlers (22). Philmech's estimate on postharvest losses in corn in 1994 was 13% (22). An assessment of postharvest losses in Northern Mindanao particularly in the provinces of Bukidnon and Misamis Oriental found out that high losses were incurred in harvesting and shelling (5). Improvement of facilities may have caused the decrease of postharvest losses. The efficiency of postharvest activities in the region has increased and in 2011, the value of losses had decreased to 4% (16).

Table 2

Number of trees, total nut production, green nut production, copra production, number of issued permits to cut, number of trees cut and coconut product exports in Northern Mindanao for 2010 and 2011.

| Parameter | 2010 | 2011 | % Change |
|--|---------|---------|----------|
| Total nut production (in million pieces) | 1,746 | 1,737 | -0,52 |
| Green nut production (in million pieces) | 2,293 | 2,222 | -3,10 |
| Copra production (t) | 423.200 | 471.200 | -1,42 |
| Number of permit to cut issued | 333 | 580 | 74,17 |
| Number of trees cut | 12.292 | 64.848 | 427,56 |
| Coconut product export (in million \$) | 417.665 | 528.588 | 26,56 |

Source: (16)

Table 3

The regional status of significant coconut product export of Northern Mindanao for 2010 and 2011 (in million PhP and Euros).

| Coconut Product | 2010 | | 2011 | | %Change |
|------------------------|-------------|-----------|-------------|-----------|---------|
| | Million PhP | Million € | Million PhP | Million € | |
| Coconut Chemical | 188,854 | 3.142 | 288,997 | 4.808 | 53,03 |
| Coconut oil | 181,167 | 3.014 | 222,066 | 3.694 | 22,58 |
| Dessicated coconut | 14,99 | 0,249 | 28,763 | 0,479 | 92,48 |
| Copra cake/meal | 18,207 | 0,303 | 12,251 | 0,204 | -32,71 |
| Coconut shell charcoal | 6,807 | 0,113 | 13,351 | 0,222 | 96,14 |
| Coconut water | 0,702 | 0,012 | 10,014 | 0,167 | 1326,50 |
| Coconut milk powder | 2,704 | 0,045 | 4,795 | 0,080 | 77,33 |
| Activated carbon | 2,031 | 0,034 | 3,335 | 0,055 | 64,20 |
| Coconut cream | 1,573 | 0,026 | 3,275 | 0,054 | 108,20 |
| Reduced fat coconut | 0,372 | 0,006 | 0,916 | 0,015 | 146,24 |
| Sweetened coconut | | | 0,380 | 0,006 | |
| Palm oil fatty acid | | | 0,235 | 0,004 | |
| Coconut vinegar | 0,006 | 0,000 | 0,024 | 0,000 | 300,00 |

Source: (16)

Currency conversion rate: PhP60.11: €1.00

Coconut, the highest value in export

The contribution of coconut to the regional economy is PhP9.05 billion (€0,151 billion) and Lanao del Norte, Misamis Occidental and Misamis Oriental are the three top coconut producing provinces in Northern Mindanao (1).

Regional coconut production data in 2010 and 2011 are shown in table 2. The slight decrease in total nut production, green nut production and copra production were due to the increase in the number of coconut trees that were cut. However, its effects on the total nut produced are very slight because the coconut trees that were cut for lumber are those that were senile and economically unproductive. Furthermore, in 2011, the moratorium on the cutting permit issuance and the subsequent transport of coconut lumber was lifted (16).

In spite of the decrease in nut production, there is an increase of coconut product export.

Table 3 presents the status of exportation of coconut commodity in Northern Mindanao. It can be noted that the exported products had passed through processing. The overall coconut product exports between 2010 and 2011 had increased by more than 26.56% and total export value was PhP14.14 billion (€0,235 billion) with 64.21% share to the total export of the region (16). Except for copra cake/meal, exports of coconut product commodities had increased significantly in 2011. There is significant increase in demand of desiccated coconut, shell charcoal, coconut water, cream, reduced fat coconut and coconut vinegar. Markets on sweetened coconut and palm oil fatty acid are found abroad.

Table 4

Top five vegetables produced in Northern Mindanao in 2011 (values in PhP and Euros).

| Vegetable | | Volume | Value | Value |
|-------------------------------------|--------------|--------|-------------|-----------|
| Scientific Name | Common Name | (t) | (x1000 PhP) | (x1000 €) |
| <i>Lycopersicon esculentum</i> Mill | Tomato | 51.109 | 247.041 | 4,111 |
| <i>Maxima cucurbita</i> Duchesne | Squash | 15.825 | 29.910 | 498 |
| <i>Solanum tuberosum</i> Linn. | White Potato | 6.745 | 66.843 | 1,112 |
| <i>Brassica oleracea</i> Linn. | Cabbage | 5.752 | 39.342 | 655 |
| <i>Solanum melongena</i> Linn. | Eggplant | 4.102 | 21.196 | 353 |

Source: (16)

Currency conversion rate: PhP60.11:€1.00

Table 5

Carrot production volume in the Philippines in 2012.

| Region | Volume (t) |
|------------------------------|------------|
| Cordillera Autonomous Region | 60.123 |
| Central Visayas | 4.169 |
| Ilocos Region | 4.143 |
| Davao Region | 1.423 |
| Northern Mindanao | 1.296 |

Source: 5

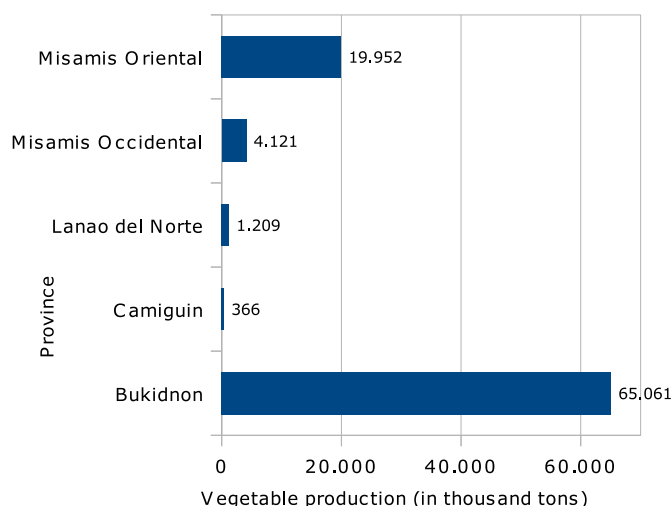


Figure 5: Vegetable production of Northern Mindanao by province, 2008.

Source: 4

Export values are increasing and high values are on products that had undergone processing. Refining coconut products before selling abroad create jobs in the labor market which can provide the financial and food security of the people in the region. Coconut water which was once a waste in copra making is recently a multi-million pesos worth of export. Furthermore, the increasing demand of coconut vinegar and sweetened coconut in the international market may be a good opportunity for home or cottage industries to flourish which can augment household income. Coconut product development that does not need intensive capital may be worth exploring.

Vegetables and their contributions to the regional economy

Growing vegetables is appropriate for farmers with small land holdings because of its relatively short growing period, it is labor intensive, it is characterized by high land productivity and it can fit well as rotation crops in traditional agricultural production systems (8). Most of the vegetable varieties have higher market values than rice or corn. Bukidnon leads the vegetable production in Northern Mindanao (4). The regional vegetable production is presented in figure 5. Because of favorable climatic conditions, vegetable farming is a lucrative venture in the province which is a source of income to small farm holders (11).

Table 4 shows the 2011 major vegetable productions in Northern Mindanao. Tomato is primarily produced in Northern Mindanao and the region is the top producer in the Philippines and the region is second in cabbage production (2).

Although carrot (*Daucus carota* var. *sativus*) production does not belong to the top vegetable industry in Northern Mindanao, the region's contribution to the national production volume is significant as it ranks fifth (Table 5). Vegetable plot sizes along the slopes of Mt. Kalatungan in Marayon do not exceed even half a hectare.

The modal class of plot sizes are from 1,250 to 1,750 square meters with the smallest is 160 square meters and the largest; 4,175 square meters. Although vegetable gardens are labor intensive, the work requirements in a relatively small size area can be supplied mostly by farm owners. As harvest frequency is higher, farmers can get income regularly.

Carrots and White Potatoes (*Solanum tuberosum* L.) as high value commercial vegetables

The national volume of carrot production in 2012 (1) was 68,438 t with an average yield of 13.91 t ha⁻¹ while the regional estimates on production volume and yield are 1,296 t and 9.5 t ha⁻¹ respectively (1). Carrots in the region are predominantly grown along the volcanic foot slopes of Mt. Kitanglad and Mt. Kalatungan, (Bukidnon, province). In the study conducted by the authors on the predominant crops at Miarrayon Village in Kalatungan, yield of carrots is 19.6 t ha⁻¹, which is higher than the regional and national average values. Soils developed on volcanic parent materials are generally believed to be productive (25) and can support intensive commercial agriculture (23). Soils in Miarrayon which are intensively used for commercial vegetable crop production are derived from volcanic materials.

The national yield average for potato in 2012 was 14.77 t ha⁻¹ and the Bukidnon average value is 11.91 t ha⁻¹ (1). Twenty commercial white potato varieties were evaluated in Impasugong, Bukidnon, seven of which made a total yield of 40 t ha⁻¹, when Granola, the check variety gave 28.91 t ha⁻¹ (6). These figures are higher than the yields obtained by Duna et al. (6) in an adaptation trial carried out in Miarrayon, Lirongan and San Miguel. In this trial the white potato productions were respectively 26.16 t ha⁻¹, 23.19 t ha⁻¹ and 25.63 t ha⁻¹ (26). White potato yield measurements conducted by the authors in Miarrayon revealed that the average in two locations, Salsalan and Mambuaw were 28.91 and 20.01 t ha⁻¹ respectively. Therefore, the average yield value in Miarrayon is higher than the provincial and national values.

Miarrayon area had long been identified as suitable for white potato crops because of its favorable soil, elevation and climatic conditions (13). The disparity of yield results between the macro statistics and the field yield investigations may indicate that potential yield of carrots and potatoes in the region is not attained.

Vegetable production support system

A study of marketing commercially grown vegetables in Bukidnon found out that vegetable production was for the market and most of the farmers preferred to sell their products to the wholesalers (15). This is practiced by farmers for forty years. Miarrayon does not have processing facilities to handle product surpluses and therefore the commodity is highly affected by price fluctuations. Historically, products were brought to the vegetable terminals in Calapat, Talakag or to Songco, Lantapan and were transported by animal driven sledge, carts or by people. At present, vegetables from Miarrayon are brought directly to the wholesalers at the West Bound Terminal Market in Bulua, Cagayan de Oro City. Trucks may also be owned by financiers who are wholesalers/retailers. Horses are used to haul the products from the field towards the road where the trucks pick the vegetables up and deliver them to the market. Carrots, potatoes and cabbages are packed in empty nylon bags initially used for rice and feeds. Tomatoes are stored in boxes. Broccoli are wrapped in paper and put in bamboo baskets. Transport from Miarrayon would go to Cagayan de Oro market through the Talakag road as this can save kilometers of travel. However, during rainy seasons, at instances when road is not passable, the transport goes through the Lantapan-Malaybalay road which is almost double the distance of the Talakag route. This situation can delay the shipping of perishable products and increase the cost of transport.

The 1972 vegetable marketing study reported that buyers and neighbors were the main sources of price information and prices of vegetables aired on radio station was useful to the farmers to some extent (15).

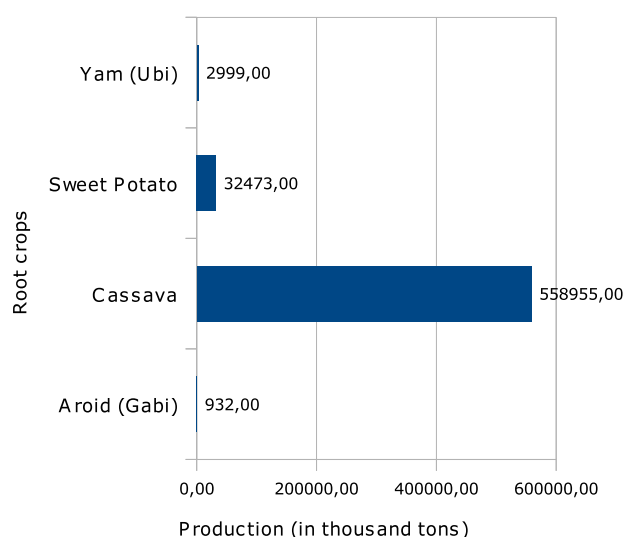


Figure 6: Root crop production volume by commodity of Northern Mindanao in 2012.

Source: 1

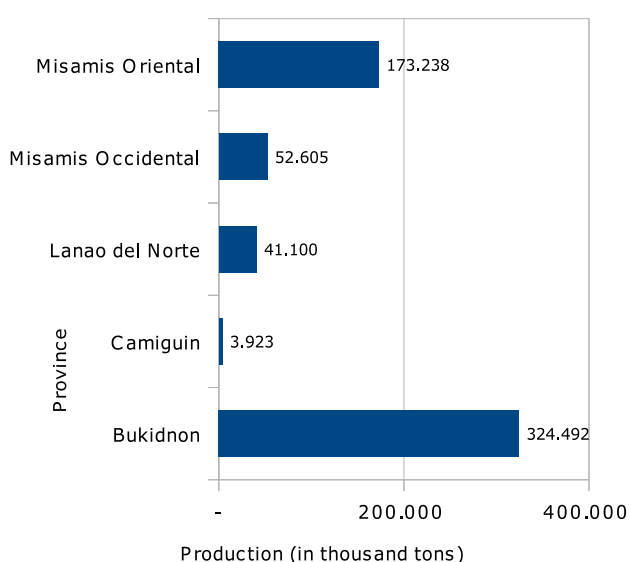


Figure 7: Root crop production volume of Northern Mindanao by province in 2012.

Source: 1

Presently, the field financiers are the ones who advise the farmers on the prices and dictate the schedule of harvests according to market supply and demand. If commodity supply is high, the farmer may shortly delay the harvest schedule for a few days. Farmers do not know the exact volume of vegetables produced when harvested because these are brought to the wholesalers' stall in Westbound

Market Terminal for weighing and valuation. If the farmer will opt not to accompany his/her products to the market, the financier will advise the value of goods through a statement of his/her accounts.

The vegetable industry in the region is more focused on production and marketing as fresh vegetables. Not many activities are geared towards processing and value adding. Over supply in the market pulls down the prices below the level farmers would accept to sell. Farmers would prefer to leave the vegetables to rot in the fields rather than bring them to the markets because the transport itself can add to their losses. In Marayon for instance, when price of carrots will go down to the point where the farmers will incur losses, more rejected tubers will be generated because these cannot be sold in the market. If these could be processed and market is available, those unsold tubers would be beneficial. Product development and value adding are worth exploring for the vegetable industry to be more beneficial to the small farmers.

As mentioned, vegetable farming is a lucrative business in Bukidnon but who profits most? In a farmer's plot financing system, farmers get their inputs from the financiers who are the middlemen, who are at the same time transportation owners and buyers of the produce. The agro production chain of the commodity needs to be studied for appropriate valuation of the products in order to identify which part in the chain gets the most benefit. Moreover, the values of cooperation among farmers have to be encouraged. The absence of credit unions makes the farmer-owner or farmer-crop sharer dependent on the financiers for farm inputs.

Root crops, for food and industrial processing

Important root crops in Northern Mindanao are: cassava (*Manihot esculenta* Crantz), sweet potato (*Ipomea batatas* Linn.), aroids or gabi (*Colocasia esculenta* Linn Poir), and yam or ubi (*Dioscorea alata* Linn.).

Figure 6 shows the estimated volume of production for the four regional important root crops and figure 7 shows the estimate of root crop production of Northern Mindanao. The volume of cassava in 2011 is 551,123 t. At a farm gate price of PhP2.70 (€0,04), this has total production value of PhP1.448 million (€0,024 million) (1).

Among the five provinces in the region, Bukidnon is the highest producer of root crops followed by Misamis Oriental (Figure 7).

Root crops are important raw materials for both food and industrial processing. These are also essential and even staple food for people in the mountains who do not/seldom have access to rice or corn. Cassava is the region's major root crop product followed by sweet potato. Cassava is used for food and raw materials for starch and livestock feeds.

Root crops are important to highland marginal farmers during dry season because they are resistant to drought. These are the sources of food and income during lean periods when vegetables and other water demanding crops would not survive. Developing food products from root crops and value adding can augment home or cottage industries income. This may also enhance the micro scale marketing of root crops. Producers who are the sellers shall have direct contact with the buyers omitting as many middlemen as possible.

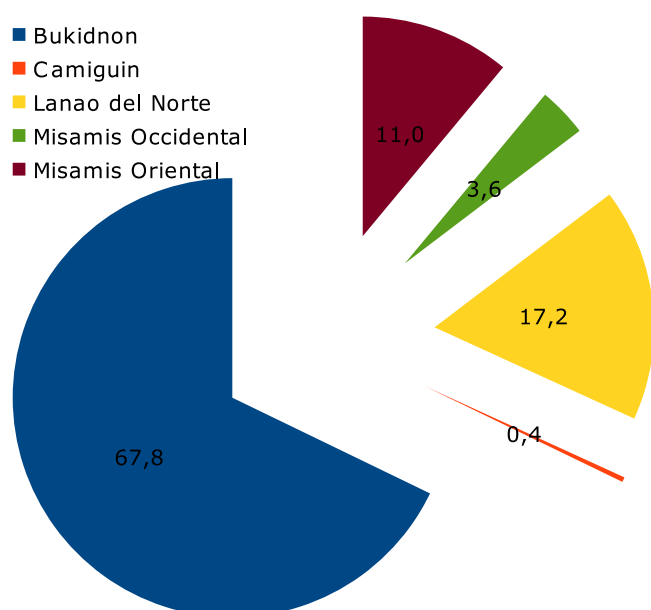


Figure 8: Banana production volume of Northern Mindanao by province in 2012.

Source: 1

Sugarcane, bananas and pineapples, the top industrial and fruit exports of Region 10

Before the Second World War, sugar had comprised 60% of the Philippine exports and contributed over 40% to the income of the government (9).

The first sugar industry in the Philippines was established in Negros Oriental when Iloilo opened its port to the British in 1855 and the first sugar mill was put up in 1857 (24). Latest data shows that the national sugarcane production volume is 26.396 million tons with a current price value of PhP42.497 billion (€0.707 billion) (1). In Northern Mindanao, sugarcane can only be found in Bukidnon. The sugar industry in the province formally started in 1975 when it was discovered that Bukidnon's wide lands are suitable for sugarcane (10). Recently its contribution to the national production is 15.33% with a current value of PhP6.513 billion (€0.108 billion) (1). The value of exported cane raw sugar is PhP2.805 billion (€0.047 billion), the fourth in the top ten export commodity list of the region in 2011 (16).

Pineapple is a major product of Bukidnon. The first pineapple plantation in the country, the Philippine Packing Corporation, now Del Monte Philippines was established in the province in 1926 by the California Packing Company, an American agribusiness firm (24). In 2012, Bukidnon's pineapple had contributed 53.34% to the country's total volume of production with a current value of PhP7.59 billion (€0.126 billion) (1). Pineapple is exported to other countries as fresh or canned fruits. In 2010, the value of exported canned and fresh pineapples were PhP3.265 billion (€0.054 billion) and PhP514.630 million (€8.561 million) respectively (3).

Regional production volume of banana (*Musa sapientum* Linn.) was estimated to be 1.726 million tons (1). Figure 8 shows the banana production volume by province. Banana varieties are cavendish, lakatan and saba, the later two are native varieties. The first cavendish banana industry in Bukidnon was opened in 1999 by Dole Philippines Incorporated. A significant increase in production was noted in 2008 when the cavendish production in Bukidnon was doubled.

Sugarcane, bananas and pineapples are competitors to corn and rice in using the land because of their demand in the international market. In the region, corn and rice fields are converted into plantations of sugarcane or bananas or pineapple due to higher profitability of the latter. This trend threatens food self-sufficiency in the region. Since these commodities are for markets abroad, there is also virtual export of water and soil nutrients. Therefore, there is need to study the social and environmental impacts of the shifting land use to plantation crops in relation to food supply and availability in the region for a better decision making.

Bukidnon soils

The contributions of soil to an agricultural economy and likewise to the food security of the society are indirect. However, as an indispensable natural resource, it is necessary for the agriculture stakeholders to be informed on its status for appropriate management in order for this asset to sustainably support crop production. Bukidnon as the source of most agricultural crops in the region has soils which are mostly derived from volcanic parent materials that generally can support intensive commercial agricultural production. Socio-economic reasons such as agricultural land ownerships, land use competitions in the lowlands and rising population in the highlands had prompted the use of marginal lands for crop production. Marginal lands as the frontiers of the Philippine agriculture are encroached. In Bukidnon, there are undifferentiated areas in mountainous lands which are left unstudied thus soil information in these areas are not available. Availability of detailed soil information and yield data at plot level in these areas are constrained.

The study conducted by the authors in Miarrayon which is located along the foot slopes of Mt. Kalatungan on the relationships between soil, rock and relief revealed two soil types using the World Reference Base of the Food and Agriculture Organization (7), the "Andic" Cambisol in more exposed, flat and convex positions, and "Andic" Umbrisol at the foot slopes and in concave positions. Investigations further found out their potentials (Umbrisols) such as topsoil high organic

matter content (10.6 to 23.2%), generally high in CEC (38.3 to 82.0 cmol/kg⁻¹) in topsoil and in subsoil (20.2 to 52.2 cmol/kg⁻¹), low bulk density (0.68 to 0.97 kg dm⁻³), high water retention (0.75 to 0.151 cm cm⁻³) but was observed to have rapid drainage during intense rainfalls. The soil characteristics in these areas and the yields of prevailing crops generally indicate that soils are fertile except for the levels of available Phosphorus (<1 mg 100 g⁻¹) as an "apparent" limiting nutrient which is typical in soils of volcanic parent material origin. Constraints found were presence of rock outcrops, stoniness, high soil erodibility, low topsoil pH (<5.5) with associated risks of Aluminum toxicity and high Phosphorous retention (68 to 98%).

Conclusion

Agriculture is a significant contributor to the economy of Northern Mindanao. Opportunities are there because its environment is generally favorable to cultivation of a broad range of crops. Although for many years advancements in agriculture have occurred in the region and the sector employs the greatest number of workforce in the rural areas, poverty remains high. Food security issues and how these can be addressed by rural agriculture are challenges to be met. One has to look into how the macro scale economy affects the individual households in order to have a realistic view of the holistic economic situation of Northern Mindanao. This paper presents the situation of agriculture in Northern Mindanao and the contribution of its major crops to the regional wealth. This also describes how vegetable and other major products have impacted to the economy.

The region has a deficit in terms of rice supply which jeopardizes the food security of many. Corn is the biggest contributor to the region's monetary resources. However, yellow corn production is given more attention than white corn. Coconut is the top export commodity with processed products that are sold in international markets. Promotion of processing and manufacturing would create jobs which are good for the micro and macro economy. Vegetable farming is a promising venture for small land holders. However, there is need to study the

agro production chain of the commodity to address the challenges that farmers are facing.

Product development for vegetables and root crops need to be explored. For agro-industrial crops, the carrying capacity of the land has to be studied and its impacts on food availability have to be quantified for better decision making in land use shift.

Acknowledgement

The authors acknowledge the support of the Cooperation of Universities for Development– Inter University Program of Belgium to the EPaM Project conducted in the Philippines and to the project partners: the University of Liege-Gembloux Agro-Bio Tech, the Catholic University of Louvain and the University of Namur in Belgium, and in the Philippines, the Environmental Science for Social Change, Xavier University and Ateneo de Davao University. Likewise, we are grateful to the anonymous reviewer for the comments and suggestions to the paper.

Literature

1. Bureau of Agricultural Statistics, 2013, Country Stat of the Philippines. Bureau of Agricultural Statistics, Quezon City, Philippines, www.bas.gov.ph.
2. Bureau of Agricultural Statistics, 2012, Major Vegetables and Root Crops, Quarterly Bulletin, October to December 2011, Volume 6, Number 1, Bureau of Agricultural Statistics National Office, Quezon City, Philippines.
3. Bureau of Customs, 2010, Export Performance by Commodity, Region 10. Performance Level Monitoring. Bureau of Customs Region 10, Cagayan de Oro City, Philippines.
4. Department of Agriculture Regional Field Unit-10, 2009, Agricultural Profile of Northern Mindanao, Department of Agriculture Rural Field Unit Region 10, Cagayan de Oro City, Philippines.
5. Dumayaca C.A., Madriaga C.S., Gamila E.B., Margate E.E., Bercero D.II., Embajador M.B., Arao J.B., Rejas R.T., Maquiso J.A. & Intong J.F.B., 2002, Postharvest Losses Assessment in the Identified Corn Farm Clusters in Region 10, Research Compendium, Northern Mindanao Integrated Agricultural Research Center, Department of Agriculture Regional Field Unit 10, Dalwangan, Malaybalay City, Philippines, 31- 53.
6. Duna L.V., Tumapon A.S., Salvani J.B., Maghanoy C.C. Jr., Ramos L.A. & Winters M., 2002, Adaptation Trial of Various Potato Cultivars for Yield, Processing and Bacterial Wilt Resistance, Research Compendium 2002, Northern Mindanao Integrated Agricultural Research Center, Department of Agriculture Regional Field Unit-10, Dalwangan, Malaybalay City, Philippines, 19-30.
7. Food and Agriculture Organization, 2006, World Reference Base for Soil Resources, A framework for international classification, Food and Agriculture Organization of the United Nations. Rome, Italy, 128p.
8. Holmer R.J., 1997, Sustainable vegetable production for small farmers on problem soils in the highlands of Bukidnon, Philippines for fresh market and processing, PhD Dissertation. Technical University of Munich, Germany, 239p.
9. Honrado P.A., 1952, Philippine Sugar: The Long View in Half a Century of Philippine Agriculture, Bureau of Agriculture, Philippines. Bureau of Agriculture Golden Jubilee Committee. Philippines, 190-198, 463 p.
10. Lao M. M., 1992, Bukidnon in Historical Perspective 1946-1985, A Tale of Growth and Progress of an In land Mindanao Province after World War II, Volume II, Central Mindanao University, Musuan, Bukidnon Philippines, 166-192.
11. Lapoot C.R., Salvani J.B., Duna L.V, Bicomon R. & Tulin A.B., 2010, Enhancing farmers knowledge on

- soil and crop nutrient management for vegetable production in Bukidnon, Northern Mindanao, Philippines, Paper presented to the 19th World Congress in Soil Science, Soil Solutions for a Changing World, 1 to 6 August 2010. Brisbane, Australia, 158-161.
12. Lapoot C.R. & Duna L.V., 2001, Balanced Fertilization of Corn, Research Compendium 2001, Northern Mindanao Integrated Agricultural Research Center, Department of Agriculture Regional Field Unit 10, Dalwangan, Malaybalay City, Philippines, 162- 188.
 13. Mariano J.A., Yniguez T.M., Aguas E. H., Marfori R.T., & Villanueva I. E., 1955, Soil Survey of Bukidnon Province with a Discussion of the Chemical Characteristics and Fertilizer Requirements of the Soils of Bukidnon Province, Department of Agriculture and Natural Resources, Manila, Philippines, 90 p.
 14. Merino G., 1952, Introduction, in Half a Century of Philippine Agriculture, Bureau of Agriculture, Philippines. Bureau of Agriculture Golden Jubilee Committee, Philippines, 463 p.
 15. Mugot I.O., 1972, Marketing of Commercially Grown Vegetables in Bukidnon, Unpublished MSc Thesis, Graduate School, Xavier University, Cagayan de Oro City, Philippines, 212 p.
 16. National Economic Development Authority, Region 10, 2012. Northern Mindanao Socio Economic Report 2012, National Economic Development Authority Northern Mindanao Region 10, Cagayan de Oro City, Philippines, 62 p.
 17. National Economic Development Authority, Region 10, 2006, Northern Mindanao Socio Economic Report 2006, National Economic Development Authority Northern Mindanao Region 10, Cagayan de Oro City, Philippines, 62 p.
 18. National Statistical Coordination Board, 2013, First Semester Per Capita Poverty Threshold and Poverty Incidence among Families by Region and Province: 2006, 2009 and 2012. Government of the Philippines, URL: <http://www.nscb.gov.ph>, Downloaded 13 July 2013.
 19. National Statistics Office, 2013, Census and Housing Population, Quickstat Region X 2013. Government of the Philippines, URL: www.census.gov.ph, Downloaded 13 July 2013.
 20. National Wages and Productivity Commission, 2013, Summary of Current Regional Daily Minimum Wages Rates, Department of Labor and Employment, Philippines. [Http://www.nwpc.dole.gov.ph/pages/statistics/stat_current_regional.html](http://www.nwpc.dole.gov.ph/pages/statistics/stat_current_regional.html), Downloaded: 2 December 2013.
 21. Philippine Crop Insurance Corporation-Region 10, 2010, 11-Year Insurance Production: Palay and Corn Total Sum Insured. Department of Agriculture, Region 10, Cagayan de Oro City, Philippines.
 22. Philippine Center for Postharvest Development and Mechanization, 2012, Comparative Loss Ranges by Postharvest Operations for Corn, Department of Agriculture, Republic of the Philippines. www.philmech.gov.ph/?page=phlossinfo. Downloaded 5 September 2013.
 23. Poudel D.D. & West L.T., 1999, Soil Development and Fertility of a Volcanic Slope in Mindanao, the Philippines. Soil Sci. Soc. Am. J., 63, 1258-1273.
 24. Putzel J., 1992, A CAPTIVE LAND. The politics and agrarian reform in the Philippines. Ateneo de Manila University Press, Bellarmine Hall, Katipunan Avenue, Loyola Heights, Quezon City, Philippines, 427p.
 25. Raymundo M.E., & Vicente P.R., 1985, Crop Production Capabilities of a Volcanic Ash Soil and Tropical Latosols in the Philippines, Soil Taxonomy: Tool for Agro technology Transfer. Proceeding of the 7th International Forum on Soil Taxonomy and Agro technology Transfer, 195- 207.
 26. Tatoy B.F., Abragan F.N., Lapoot C.R., Apiag C.T., Salvani J.B., Madriaga C.S., Bach, A.P., Tumapon A.S., Duna L.V., Dumayaca C.A., Flores M.A., Ramos L.A. & Maape E.S., 2001, Bacterial Wilt Management in Potato through Agro-Technical Approach, Research Compendium 2001, Northern Mindanao Integrated Agricultural Research Center, Department of Agriculture Regional Field Unit-10, Dalwangan, Malaybalay City, Philippines, 34- 55.
 27. World Bank Group-Asian Development Bank, 2007, PHILIPPINES. The Indigenous Peoples Rights Act: Legal and Institution Frameworks, Implementation and Challenges, Discussion Papers. Sustainable Development Department, East Asia and the Pacific, World Bank, Manila, Philippines, 67p.

G. M. Dejarne–Calalang, Filipino, PhD, Associate Professor, Xavier University, College of Agriculture, Cagayan de Oro City, Philippines.

L. Bock, Belgian, Professor, University of Liege-Gembloux Agro-Bio Tech, Gembloux, Belgium.

G. Colinet, Belgian, Associate Professor, University of Liege-Gembloux Agro Bio-Tech, Gembloux, Belgium.