



# Agricultural development and habitat change in the Agusan River Basin in Mindanao, Philippines

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## Abstract

The vast land and fertile soil in the Agusan River Basin lured people to use the land for agricultural and tree plantations. The agricultural plantation development in the floodplain may have some implications to the wetland ecology, particularly on the water movement, biodiversity and in the overall relationships of the various aspects of the basin. Thus information on the agricultural plantation development and the use of agrochemicals that can contribute to water contamination in the basin were assessed as inputs for the management of Agusan River Basin toward sustainable development. Corn and rice are the dominant agricultural crops planted in the river basin. For the period 2005-2012, area for rice and corn production has been expanding. Likewise, the production area of oil palm (*Elaeis guineensis* Jacq.) is increasing in the buffer zone of the basin. The contract growing scheme of large oil palm companies in Agusan del Sur is the major driver that encouraged landowners and cooperatives to venture in oil palm production resulting to the conversion of natural habitats in the buffer zones. Expansion of banana plantation and rubber has also reached the drier areas of the basin. The continued expansion of agricultural areas has changed the habitats in the basin. With the land use conversion, interconnectivity is reduced which is detrimental to the biodiversity. A policy review is, therefore, necessary to look at how to strike a balance between food production and biodiversity conservation.

**Keywords:** Land use, Agricultural development, Biodiversity conservation, Wetland ecology

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## 1. Introduction

Food security is a major concern in many regions in the world particularly in the underdeveloped and developing countries like the Philippines. To address the issue on food security, natural habitats such as forests and wetlands have been converted into agricultural production areas. This is the scenario in the Agusan River Basin.

Agusan River Basin is located in the eastern part of Mindanao Island in the Philippines. It covers both the Agusan Valley and the Compostela Valley. For management purposes, the basin is subdivided into 3 portions, wherein the Agusan Marsh is referred to as the middle basin. The Agusan Marsh, covering a total area of 111,540 hectares (AMWS, 2001), is among the prominent features in the basin. The marsh absorbs much of the water during flooding episodes thus serving as a flood-control system for the entire Agusan River Basin. Moreover, the marsh harbors unique and pristine habitats like the sago, *Terminalia* and peat swamps forest and is a home to endangered and endemic flora and fauna. However, the vast land and fertile soil in the basin attracted many people to use the land for tree and agricultural plantations. At present, oil palm and falcata tree plantations are very common sceneries along the basin. DENR (2010) reported that over 216,00 hectares of land adjacent to the marsh are planted to Falcata and other fast-growing species. Rice, corn and other short-term crops can likewise be seen during the drier months of the year. Expansions of banana plantation and rubber have also reached the peripheral areas of the basin.

These developments in the Agusan River Basin may have some implications to the ecology of the entire basin. It may impact on the water movement, biodiversity and in the overall relationships of the various aspects of the basin (Varela. 2012; Varela and Gapud, 2013). Thus information on the agricultural plantation development, the provincial and municipal plantation development plan along Agusan River Basin are indeed necessary for the sustainability of the river basin.

## 2. Materials and methods

### 2.1. The study site

The Agusan River Basin, located in the eastern region of the Mindanao Island, is third largest river basin of the Philippines. It has a total drainage area of 10,921 km<sup>2</sup> and stretches 350 kilometers from its headwaters to Butuan Bay where it empties. It is the catchment of the majority of water of the Caraga Region and some parts of Compostela Valley and Bukidnon. It is divided into three sub-basins on the basis of topographic features: (i) lower Agusan River Basin, which is the area along the downstream reach from Amparo in Agusan del Norte Province; (ii) middle Agusan River Basin, which mainly covers the area of Agusan Marsh in Agusan del Sur Province; and (iii) upper Agusan River Basin, which is the area along the upstream reach from Sta. Josefa to Compostela Valley Province (Figure 1).



**Figure 1.** Map showing the Agusan River Basin (highlighted portion) in Mindanao, Philippines (taken from the Agusan River Basin Task Force)

## 2.2. Data collection and analysis

Data were gathered through survey and field evaluation. Likewise, data from LGUs, PENROs, DA-PAOs and NIA, were taken to serve as basis in the gathering of primary data. All data were analyzed statistically. The data generated from the survey and field evaluation were inputted into the database.

## 3. Results and discussion

### 3.1. Oil palm plantation

Oil palm (*Elaeis guineensis* Jacq.) is an introduced crop in the Philippines. In 1979, NDC-Guthrie Plantations, Inc. introduced the crop in Agusan del Sur which increased in the early 80s, and this gave way to the establishment of the NDC-Guthrie Estates, Inc. In the '90s and at the turn of the century, more areas in Agusan del Sur were developed into oil palm estates.

Table 1 presents the major oil palm plantations in the vicinity of the Agusan River Basin. Presently, the number of contract growers is escalating due to the demand for oil worldwide and the existence of 2 milling

plants with high milling capacities, namely: Filipinas Palmoil Plantations Inc. (formerly known as NDC-Guthrie Plantations, Inc) and Agumil in San Francisco and Trento, Agusan del Sur, respectively.

**Table 1.** Major oil palm (*Elaeis guineensis* Jacq.) growers within the Agusan River Basin

Name of Firm	Location	Date Established	Plantation Area (ha)
Filipinas Palmoil Plantations, Inc.	San Francisco & Rosario Agusan del Sur	1979 & 1983	8,429.68
Agusan Plantation Inc	Trento , Agusan del Sur	1993	1,815
Evergrow Dev't Agricultural Farm, Inc.	Trento, Agusan del Sur	1998	350
Kabingwangan Upland Farmers Tribal MPC	Bunawan Agusan del Sur	1999	440
Uraya Farms	Bunawan Agusan del Sur	-	666
Agusan del Sur State College of Agriculture and Technology	Bunawan, Agusan del Sur	2002 & 2005	70
<b>Total Area</b>			<b>11,770.68</b>

Recent expansions of oil palm plantations can be seen in the peripheral areas of Agusan Marsh particularly in Kalingayan, Bunawan, Agusan del Sur and Novele, Rosario, Agusan del Sur. Moreover, areas planted to oil palm have increased in Sta Josefa and Trento (Table 2). In other towns, few areas have been opened but not aggressively expanding as manifested in La Paz, Loreto and Talacogon. Downstream (Agusan del Norte-Butuan portion), about 300 hectares have been planted to oil palm since 2003 to date (Caraga Oil Palm Industry Cluster Report, 2009). The areas covered Florida, Dulag and Aupagan, Butuan City.

### 3.2. Plans for oil palm plantation expansion

Contract growing of oil palm has been the trend in Agusan del Sur particularly in Trento where Agumil is the major market for the produce. This strategy lures many farmers to convert their underutilized farm lands into oil palm plantation. Although in the Strategic Agriculture and Fishery Development Zone (SAFDZ) mapping there are only areas based on ecozone identified for oil palm planting, the government cannot prevent the landowner to plant whatever he/she wishes to plant.

The SAFDZ specifically maps out areas suitable for particular agricultural crops with consideration of the soil and water characteristics, slope and crop suitability in relation with the prevailing climate. Nonetheless, this instrument only serves as a guide due probably to the lack of strong political will to implement the zonal planting of agricultural crops. The SAFDZ is part of the national agricultural land use policy which integrates

ecological soundness and environmental protection as a basic component for agricultural and agro-industrial development.

**Table 2.** Area planted to oil palm (*Elaeis guineensis* Jacq.) within the Agusan River Basin

Municipality	2005 Production Area (has.)		2009 Production Area (has.)	
	Old Planting	New Planting	Old Planting	New Planting
San Francisco	5,406.08	348.57	5,502.27	292.08
Rosario	3,225.74	939.36	3,694.26	220.65
Bunawan	1,538.96	154.73	1,072.46	340.05
Trento	2,327.33	397.86	2,852.12	442.22
Sta. Josefa	292.48	109.00	617.95	454.73
Veruela	38.02	0.90	94.38	123.74
Loreto	368.34	315.87	388.21	93.11
La Paz	105.94	75.00	152.86	15.06
Talacogon	10.00	48.00	50.74	53.31

Source: Philippine Coconut Authority (PCA) as of May 2010

Recently, conversion of forest lands and idle lands in the buffer zones of Agusan Marsh into oil palm plantations appears to be gaining strength. This results to oil palm plantation expansions in several areas in Agusan del Sur. Contract growing scheme encourages many landowners, cooperatives and CBFM organizations to go into oil palm venture due to the financing provided and the sure market for the products.

### 3.3. Durian production

Establishment of durian orchard for durian production has also gained popularity in Caraga Region in the '90s. In Agusan del Sur, the total area allocated for durian is approximately 800 hectares. San Francisco showed the highest production area of durian among the municipalities of Agusan del Sur. Other municipalities having bigger production area of durian include Trento, Rosario, San Luis, Bunawan and Talacogon (Table 3).

The demand for durian is increasing both in the local and national markets. Although the market has become choosy, because many people prefer the Puyat variety, but there are markets that still buy the traditional varieties. This scenario gives farmers and orchard developers the idea to expand the durian area but plant the most preferred variety. Durian orchards in Agusan del Sur and Agusan del Norte are relatively smallhold. Although there are orchards with areas reaching to as high as 25 hectares, these are very rare under the Caraga setting. With the threat of diseases, particularly those caused by *Phytophthora* spp., durian

farmers and orchard developers are unenthusiastic in maintaining and/or expanding the durian production area despite the growing demand for the fruit.

### 3.4. Banana production

Banana production is one of the major sources of income among people in the locality. In the '90s, the region was the 4<sup>th</sup> largest banana producer in the Philippines, being the supplier of banana chips in the local and international market. However, with the devastation caused by a bacterial disease called 'bugtok', considerable production areas for Cardaba banana were converted into other land uses. In 2008-2009, the number of farmers benefiting from banana production reached to about 6500 (Table 4). This happened despite the fact that the production area for banana was relatively the same as that in 2007.

**Table 3.** Durian Production in Agusan del Sur within the Agusan River Basin in 2008-2009

Municipality	2008		2009	
	Production Area (ha)	Production (MT)	Production Area (ha)	Production (MT)
San Francisco	175	38.84	176	24
Rosario	74	9.4	77	6
Bunawan	135	8.13	137	5
Trento	109	936	109	300
Sta. Josefa	64.25	15.1	52	17
Veruela	56	337.5	56	400
Loreto	27	54	29	143
La Paz	37	9.81	37	1.7
Talacogon	75	38	78	33
San Luis	84	2.5	84	18
Esperanza	40	468	40	460
<b>Total</b>	<b>876.25</b>	<b>1917.28</b>	<b>875</b>	<b>1408</b>

Source: Agusan del Sur Provincial Agriculture Office (2009), Municipal Agriculture Offices (2009)

### 3.5. Rice production

Rice production is one of the major agricultural endeavors in areas within the Agusan River Basin. This is due to the available water in the area that is used for irrigation. In addition, the Agusan Valley where the Agusan

River Basin lies is suited for rice production because of the inherent fertility of the soil resulting from the deposits of humus from the upper portions.

In Agusan del Sur, among the areas with bigger production area for rice production are Bunawan, Veruela, San Francisco and Esperanza. Bunawan, San Francisco and Veruela are among the municipalities found in the buffer zone of the Agusan Marsh Wildlife Sanctuary (AMWS). Some of the rice areas were previously natural habitats of the marsh such as lanipao (*Terminalia copelandii*) forests, sago (*Metroxylon sagu*) forests or sedge-dominated swamps drained and converted into ricefields. With the establishment of irrigation facility in Veruela, the Logom-Baobo Irrigation Project, expansion of rice areas can be expected. Likewise, the irrigation facility in Rosario, Agusan del Sur also encourages the farmers to open new areas for rice production.

**Table 4.** Banana Production in Agusan del Sur within the Agusan River Basin in 2008-2009

Municipality	2008		2009	
	Production Area (ha)	Farmers Served	Production Area (ha)	Farmers Served
San Francisco	399	1914	435	1997
Rosario	107	253	106	212
Bunawan	96	196	134	212
Trento	134	493	182	657
Sta. Josefa	114.5	208	143	273
Veruela	1533	1560	1533	1608
Loreto	115	220	118	220
La Paz	115	300	221	300
Talacogon	293	462	390	529
San Luis	381	200	381	248
Esperanza	525	785	550	785
<b>Total</b>	<b>3812.5</b>	<b>6591</b>	<b>4193</b>	<b>7041</b>

Source: Agusan del Sur Provincial Agriculture Office (2010)

In Las Nieves, Agusan del Norte and Butuan City, natural habitats in the marshy areas (mainly sago and lanipao forests and sedge-dominated swamps) along the Agusan River have been converted into ricefields. In both areas, remnants of sago stands are still recognizable even at present. Interviews with rice farmers in Las Nieves and in Tagabaca and Mahay, Butuan City revealed that the major reason for the conversion of the sago forest into ricefields is economic. According to them, sago has limited economic value as it is only used for roofing as thatch and the starch is used for the production of the native delicacy known as 'palagsing' which is not economically competitive.

The same reason also applies to the conversion of lanipao forests into ricefields. Lanipao is a tree regarded to have low economic value in the area because of its relatively soft wood, which is not suited for furniture making and building construction. In Agusan Marsh, the lanipao forests have been vanishing fast as a result of the land use conversion. In fact, some areas have been drained and converted for housing purposes.

The sedge-dominated swamps are among the natural habitats in Agusan Marsh and in swampy areas along the Agusan River that are easily converted into ricefields. The reason lies in its being regarded as a wasteland. Inhabitants in Agusan Marsh consider the non-use of the sedge-dominated swamps a waste of resources because these areas are generally suited for rice production during the dry season, when water in the site is just adequate for the rice requirement.

At the rate the natural habitats are converted into ricefields, the dynamics of the wetlands may be badly affected. Thus the continued draining of natural habitats in the wetlands and converting these into ricefields must be carefully addressed because this may disrupt the ecological balance especially in Agusan Marsh where the sedge-dominated swamps, Lanipao forests and sago forests are unique natural habitats housing tremendous endemic biodiversity.

**Table 5.** Rice production In Agusan del Sur within the Agusan River Basin in 2009

Municipality	Irrigated (Inbred)		Rainfed	
	Production Area (ha)	Farmers Served	Production Area (ha)	Farmers Served
San Francisco	2,208	661	4,584	1,873
Rosario	1,362	447	1,535	572
Bunawan	4,059	1,485	1,949	894
Trento	3,717	1,153	716	220
Sta. Josefa	1,857	428	3,248	816
Veruela	2,630	625	5,407	1,553
Loreto	319	172	1,655	836
La Paz	178	65	1,657	709
Talacogon	370	133	1,146	357
San Luis	532	320	1,058	578
Esperanza	3,151	1,030	4,029	1,433
<b>TOTAL</b>	<b>20,383</b>	<b>6,519</b>	<b>26,984</b>	<b>9,841</b>

Source: Agusan del Sur Provincial Agriculture Office (2010)



### 3.6. Corn production

The corn production in Agusan del Sur continued to increase, which benefitted about 21,000 smallhold farmers in 2005. The trend continued in 2009, with the yellow corn production becoming popular, having a total production area of 6,877 hectares and a production of 33,603 MT (Table 6). The white corn production had an area of 9,932 hectares but a lower production of only 24,389 MT. This, therefore, increased the number of farmers served. In the area, planting of genetically-modified corn (GM corn) such as Bt corn and herbicide-ready corn is becoming the trend. Corn farmers who can afford the higher price of GM corn prefer to plant it due to the relative ease in crop management inasmuch as pests and weeds are avoided. The economic benefit from planting genetically-modified corn is generally higher than in using the traditional varieties or even the improved corn varieties. Nonetheless, GM corn is not yet socially accepted in many rural areas due mainly to the issues related to the environment, health and even ethics.



**Figure 2.** Thinning *Terminalia* forest due to conversion into ricefield



**Figure 3.** Marginalized sago forest due to conversion into ricefield

In Agusan del Norte, corn planting is also one of the sources of livelihood particularly in Las Nieves. Corn planting is mostly for food and feeds as the farmers plant both white and yellow corn, respectively. In the area, although many farmers already plant hybrid yellow corn, planting of GM corn is still not a trend.

The corn production areas are located mostly along the Agusan River, taking advantage of the fertile alluvial soil. The economic benefit from corn planting may not be as high, but the risk of contamination with heavy metals is high. On the situation where corn is grown along the Agusan River, there is a big risk of heavy metal contamination considering that mercury and other heavy metals had been reported to be present in Agusan River (Roa, 2007).

**Table 6.** Corn production In Agusan del Sur within the Agusan River Basin in 2009

Municipality	Yellow Corn		White Corn	
	Production Area (ha)	Production (MT)	Production Area (ha)	Production (MT)
San Francisco	26	65	393	800
Rosario	100	238	438	482
Bunawan	752	4,837	171	643
Trento	2,058	9,384	813	2,170
Sta. Josefa	1,342	6,228	157	416
Veruela	458	1,421	618	745
Loreto	18	54	766	1,668
La Paz	302	1,456	1,029	2,861
Talacogon	6	42	1,121	1,604
San Luis	-	-	1,058	1,490
Esperanza	1,815	9,878	3,368	11,510
<b>TOTAL</b>	<b>6,877</b>	<b>33,603</b>	<b>9,932</b>	<b>24,389</b>

Source: Agusan del Sur Provincial Agriculture Office (2010)

#### 4. Conclusion

The findings of the study led to the following conclusions:

1. Agricultural plantation development already encroached into the natural habitats of the Agusan River Basin, giving a real threat to the biodiversity therein,
2. Rice production and oil palm plantation development are the two most rapidly expanding land uses that can threaten the biodiversity of Agusan Marsh,

3. The continued expansion in the buffer zone of Agusan Marsh can alter habitats and their connectivity causing disturbances to the biodiversity in the marsh due to various human activities associated with agricultural operation.

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