The Productivity and Profitability of Marshland Farming System: the Case of Ligawasan Marsh in Maguindanao

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Abstract. Wetlands have been used for agriculture because of their natural fertility. This is true in Ligawasan Marsh in Southern Philippines where residents have been farming as main source of livelihood. This study determines the productivity and profitability of rice, corn and mungbean as primary crops in a marshland community in Maguindanao. It was conducted during dry season combining quantitative and qualitative design. Triangulation method was applied using survey, key informant interview, focus group discussions and observation. There were 24 farmers who participated in the study. The average yields for rice, corn and mungbean were at 1.5 t ha⁻¹, .78 t ha⁻¹, and 0.32 t ha⁻¹, respectively. Farmers earn Php 13,860.65 per ha for rice, 3,933.56 for corn, and Php 12,898.83 for mungbeans. Productivity and profitability is low compared to established data on yield and net income. Farmers, however, are spending very minimal which make them less dependent from external input. The average cost of production is lower than the established production cost. Farming in a marshland community is considered as low external input agriculture. There is a need to diversify farmers’ income including vegetable gardening, duck raising, and fishing and adopt a better cropping calendar.

1. Introduction
Farming in area near water provides opportunities for farmers to have alternative sources of income. A case in point is a study in Walpole Island [1], which compares the net operating profits obtained from hunting, fishing, and trapping from one hectare of wetland to the net operating profits obtained from agricultural land. The comparison showed that hunting, fishing, and trapping practices within wetlands provided higher profits than those obtained from agricultural practices on reclaimed land. Wetlands encompass different types, characterized by hydrological and biological characteristics. Wetlands could be fens, bogs, marshes, swamps, shallow lakes, mangroves and salt marshes [2]. Marsh is defined as “land that is waterlogged for at least part of the year”. It is an expansive freshwater wetland, essentially flat with a water table at or near the surface for much of the area. Most are alternately flooded, exposed by the movement of tides[3]. Marshes often include open water surrounded by plants which grow with their stems and leaves partly submerged[4]. Nutrients carried by flood waters and deposited on the floodplain create a rich soil. Wetlands purify the water they receive, serving as natural settling ponds where soils and vegetation can trap sediments which also stabilizes banks, thereby protecting water quality by decreasing erosion and siltation. Floodplains in river basins in many parts of the world have been used for agriculture because of their natural fertility[2]. Wetlands have been used for agriculture for millennia, particularly in floodplains where soils are fertile and water is readily available[5]. In areas with seasonal rainfall patterns, the capacity of wetlands to retain moisture for long periods means that they are of particular importance for small-scale farming. Wetlands contribute to the livelihoods of millions of people. It is considered as one of the world’s most productive and valuable ecosystems that provides a great volume of foods.
[6]. They are often linked to agricultural production systems[7]. Understandably, the impact of marshland agriculture on the environment can have social and economic repercussions. This will be more severe for people dependent on ecosystem services of the marsh. If this resource is not used sustainably, the functions which support agriculture and ecosystem services, including water-related services, are undermined.

In Lower Mekong Basin countries such as in Vietnam, Laos, Cambodia, and Thailand, the lowland crop production areas are more productive. The lowlands and deltas are relatively flat and nutrient rich, though some flooded areas cannot be planted[8]. Because of the flat terrain of marsh areas, rich organic soils, and proximity to water, many wetland areas have been found desirable for farming[9]. Existing farming systems include rice, dry season irrigated rice, flood recession rice, floating rice, and multiple cropping systems. These are gradually incorporated with fish, vegetables and fruit trees. Millions of people also depend on the Nile Basin wetlands and on the large floodplain of the Inner Niger Delta for their livelihoods in fishing, livestock raising and cultivation [8].

One of the largest wetlands in the Philippines is the Ligawasan Marsh. It has been dubbed as the largest collection of freshwater (288,000 has) floodplains in the country and is home to Maguindanaon fishermen and farmers. Residents have constantly utilised and exploited its resources which have been subjected to some degree of degradation[10]. While the effect of this utilization before was minimal, it becomes problematic after the introduction of pesticides and population increase in the area. Farmers and fishers in Ligawasan Marsh have a distinct farming system and this has not been extensively studied. For example, the establishment of floating rice seedbeds during flooding is practiced in the community. Bamboo or banana trunks are filed-up and used as floater for the seedbeds where rice seeds are sown. By the time the flood subsides, farmers now have rice seedlings ready for transplanting. There are also farming practices which can be similarly considered indigenous in the area, such as tal’mbing as a strategy to mitigate flood. Tal’mbing is a local term which refers to the temporarily planted seedlings in the more elevated area before finally transplanted to a rice field after flooding is over. The strategy also allows the seedlings to reproduce its tillers to cover a wider area of the rice field, thereby serving as a solution also to the limited quantity of seedlings initially planted. The Ligawasan is also a source of livelihood. Around 1.1 million people engage in fishing and agriculture[11]. The Ligawasan Marsh Management Alliance (2006) claims that the alluvial soils in the marsh from residues deposited by the tributaries have made the area fertile and potentially productive. Hydrosols, clay loams, and clay soils are the soil types around the marshes[12].

1.1. Objectives of the Study
One of the marshland farming areas in the Ligawasan Marsh is Barangay Pened, Kabuntalan, Maguindanao. The study aims to determine the productivity and profitability of marshland farming in Barangay Pened. The specific objectives are: to characterize the marshland farmers; to determine the productivity of marshland farming; and to determine the profitability of marshland farming system.

2. The methods
2.1. Research design
This study combined quantitative and qualitative research designs. Quantitative design seeks to quantify data and generalize results from a sample of the population of interest[13]. Quantitative data gathered through survey method include the characteristics of the study area, the productivity and profitability of farming, and the profile of farmers. The qualitative approach was used to probe and explain contextual differences in the quality of data. In this study, qualitative approach was used in describing in understanding the practices of farmers and their problems. Focus group discussions, transect walking, informal interview, and direct observation comprise the qualitative approaches. Triangulation was therefore applied in gathering information. This is a process of comparing and reflecting on the results of different approaches to synthesize data and arrive at comprehensive, clear, and easily interpreted results[14]. This method aims to have a more comprehensive picture of reality on the ground.
2.2. Research locale
Kabuntalan is one of the municipalities along the Ligawasan Marsh. It is composed of 17 barangays with a total land of 10,149 hectares. The existing land uses are a combination of agriculture, residential, and other uses [15]. Since the municipality is surrounded by bodies of water, its land capability is usually dependent on the seasonal overflowing of the rivers. Most of the area is flooded and becomes unproductive during the rainy season. This study was conducted in Barangay Pened in the said municipality. It is one of the barangays surrounding the marsh. It was selected since it has the characteristics similar to those areas nearest the marsh and the result of this study could be replicated in other surrounding barangays. It has a flat terrain with no mountains or hills. The elevated area is near the silted river bank. The slope from the silted river towards the marsh is around 2% gradient.

2.3. Statistical tools and data analysis
Descriptive statistics were used in analyzing quantitative data. The yield gap analysis was used in determining the productivity of crops in the area. Yield gap is calculated by subtracting achieved average yield from the yield potential [16]. It is operationalized as the percentage difference between potential yield (yield obtained at the research station) and the actual yield obtained in the farmers’ field. In this study, the actual yield of each crop was gathered through survey while the potential yields were from secondary sources. In computing farm profitability, the gross margin analysis was used. Gross margin for a farm enterprise is its financial output minus its variable costs [17]. The use of gross margins became widespread in 1960 when it was first popularised among farm management advisers for analysis and planning purposes. It is one measure of farm enterprise profitability that is a useful tool for cash flow planning and determining the relative profitability of farm enterprises [18]. In this study, costs of production considered were the hired labor, fertilizer, and chemicals.

3. Research findings

3.1. Characteristics of farmer-respondents
The study site, Barangay Pened has a total of 207 households in seven Sitios or Puroks [19]. There were 24 farmers from different Sitios or Puroks who participated in the study. These are all regular farmers who plant crops the whole year. Fifteen of the 24 farmers till more than one farm in separate areas. Most of them also fish when water level in the marsh is high and fishing is feasible.

3.1.1. Profile of farmer-respondents. Table 1 shows the profile of farmer-respondents. About 80% of the farmers are male, and the rest are women. Farmers are mostly in their 50s, with an average age of 52. At least 25% of the farmers are 65 years old and older. The data show similarity with the average age of rice farmers in the Philippines, which is 52, while that of corn farmers is 53[20]. Same source also mentioned that older farmers tend to hire farm labor than utilizing family labor. This aging trend among farmers is a global phenomenon. For example, the average age of farmers in Thailand is 52 years [21]. This is similarly the case in Indonesia, Korea, Vietnam, Africa, the United States, Japan, and the European Union [22].

The average household size in Pened is five. Most of the household members are male and are within the working age group (15 to 64 years old). Only 27.05% of household members are infants and 9.02% are beyond the working age group, implying that more family members are available for work both for on-farm and off-farm activities.

3.1.2. Women participation in the farm. Table 1 also shows that 52.42% of the household members are involved in farming. Around a third (33.85%) of the family members involved in farming are women. Aside from the husband and wife, children are also involved in the farm. They are part of almost all the farm activities including planting, weeding, harvesting, and marketing. Children’s participation in farming in Pened can be a positive indicator since a sizable proportion of farmers in the area are now aged. This is a relief from a nationwide survey [23] where it found out that majority of farmers do not want their children to be rice farmers, instead they want them to work on non-farming jobs in urban areas or abroad.
Women participation in farming in Pened reflects the situation in Asia and Africa where almost half of the labor forces are women [24]. Women participation is even considered as prerequisite to have a global food security[25].

### Table 1. Profile of research participants in Pened, Kabuntalan, Maguindanao.

| Indicators                  | Frequency | Percentage |
|-----------------------------|-----------|------------|
| Sex                         |           |            |
| Male                        | 19        | 79.17      |
| Female                      | 5         | 20.83      |
| Age                         |           |            |
| 20 to 29                    | 2         | 8.33       |
| 30 to 39                    | 2         | 8.33       |
| 40 to 49                    | 5         | 20.83      |
| 50 to 59                    | 7         | 29.17      |
| 60 to 69                    | 4         | 16.66      |
| 70 to 79                    | 4         | 16.66      |
| Average age: 52.04          |           |            |
| Marital Status              |           |            |
| Single                      | 2         | 8.33       |
| Married                     | 20        | 83.33      |
| Widowed                     | 2         | 8.33       |
| Ethnic Group                |           |            |
| Maguindanaon                | 24        | 100.00     |
| Average Household size      | 5.17      |            |
| Household Composition (age) |           |            |
| Dependent (younger than 15 y/o) | 33   | 27.05     |
| Working Age (15 to 64 y/o)  | 80        | 65.57      |
| Old (64 years and older)    | 11        | 9.02       |
| Household Composition (sex) |           |            |
| Male                        | 73        | 59.84      |
| Female                      | 51        | 41.80      |
| Percentage of Household members involved in farming | | 52.42 |
| Male                        |           |            |
| Female                      |           |            |

3.2. Productivity of marshland farming

The productivity of marshland farming is posted in Table 2. It can be seen that most farmers (70.83%) in Pened are engaged in rice production. There were 12 farmers who also planted corn, and eight also planted mungbean. Rice and corn farming are usually planted alternately for the whole year, one cropping for corn, and one for rice.

3.2.1. Rice. Farmers usually plant traditional local varieties known as *Tanggiling* and *Kawilan*. *Kawilan* is an upland local variety with morphological characteristics of medium size of 7- 9.5 mm length, oblong shape, light yellow lemma and palea, and translucent non-aromatic caryopsis. *Kawilan* and other upland varieties were characterized and it was reported that *Kawilan* has the highest number of tillers which is 6.5, compared with other varieties [26]. It also has the highest number of panicles per plant. *Kawilan* has longer period to flower at about 91 days. Its panicle length varies from 26.38 cm [26] and 35cm [27]. In a separate study on their characteristics [28], it was reported that *Kawilan* exhibited a yield of 3.57 t ha$^{-1}$ and *Tanggiling* had 3.51 t ha$^{-1}$. The importance of local rice varieties has been emphasized by some researchers [29]. Accordingly, local varieties are the main sources of germplasm for breeding new rice varieties since they have traits potentially adaptable to various abiotic and biotic stresses. Per account of farmers in Pened, local varieties can withstand flood for two weeks provided this is not during its reproductive stage.
Table 2 also shows that the total rice farm size of respondents in the area is 15.4 has. The average farm size per farmer is 0.91 ha with yield of 1.57 t ha\(^{-1}\). This yield is lower compared to a previous study [30] which found that the average yield for the Tanggiling and Kawilan are 3.57 and 3.51 t ha\(^{-1}\), which was close to the reported average Philippine yield for rainfed palay of 3.11 in 2017 and 3.12 in 2018. Farmers claimed that the current lower yield is due to the drought in 2018 and 2019. The PSA-ARMM reported that the average yield of upland palay in 2017 was 1.89 t ha\(^{-1}\).

3.2.2. Corn. For corn, the total farm size is a little bigger than that planted to rice, or 15.75 ha (Table 2). This is usually the same area as that for rice since these are usually planted alternately, though there are farmers who plant only either corn or rice. The average corn farm size per farmer is 1.31 ha. The average yield is 0.78 t ha\(^{-1}\). Considering the average farmlot, each farmer has an average yield of 1.03 t ha\(^{-1}\). This yield of farmers is very low compared to the established yield of white corn in the country. For example, a PSA-ARMM (2018) report shows that white corn production in 2017 in the Autonomous Region of Muslim Mindanao now referred as Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) was 2.45 t ha\(^{-1}\). In the Philippines, the reported yield for white corn was 1.79 in 2017 and 1.86 in 2018 [30].

3.2.3. Mungbean. Mungbean is among the top five produced vegetables in BARMM. In Pened, the total farm size for mungbean is 4.4 hectares. These are planted by eight farmers with an average farm size of only 0.55 ha. Production is very low at only 0.32 t ha\(^{-1}\). On average, each farmer can produce 0.18 tons grain per cropping. In an experimental study of Department of Science in Technology in 2018, it was reported that the yield of mungbean under control field was 0.15-0.31 t ha\(^{-1}\).

Table 2. Productivity of rice, corn, and mungbean in Pened, Kabuntalan, Maguindanao.

| Indicators             | Rice  | Corn  | Mungbeans |
|------------------------|-------|-------|-----------|
| Number of Farmers      | 17    | 12    | 8         |
| Total farm size (ha)   | 15.40 | 15.75 | 4.40      |
| Average farm size per farmer (ha) | 0.91  | 1.31  | 0.55      |
| Average Yield (t ha\(^{-1}\)) | 1.57  | .78   | 0.32      |
| Average Yield per farmer (ton) | 1.42  | 1.03  | 0.18      |

3.2.4. Yield gap analysis. Figure 1 shows the yield gap analysis of traditional local varieties. Based on a previous study in Datu Salibo, also one of the municipalities along the marsh, Kawilan and Tanggiling has an average yield of 3.54 t ha\(^{-1}\) [30]. The average yield in Pened is only 1.57 t ha\(^{-1}\). The yield gap (between the potential yield and actual yield) is 1.97 tons per ha. This shows that rice production in Pened has a lower yield compared to the established potential yield. Comparing the average yield of white corn in BARMM (2.45 t ha\(^{-1}\)) and the yield in Pened, it shows that the yield gap is 1.67 tons. For mungbean, the average yield in the country is 0.72. This is almost 50% lower than the established yield of 0.32 t ha\(^{-1}\) in Pened.

The lower production in Pened for rice, corn and mungbean can be attributed to the drought and pest infestation immediately before and during the study period. They did not have irrigation facilities such as water pump for irrigating both rice and corn fields. Even hand-pumped wells as sources of drinking water also dried up. It was noted that in 2017, 24% of the farmers could still have more than one cropping a year, with an average net income of Php20, 055.17 per cropping [31]. Low crop production can also be attributed to a Nitrogen-deficiency in soils in the area and the low application of fertilizer among farmers. A soil laboratory recommends that at least 4.3 bags/ha of Urea (46-0-0) should be applied in the farm for rice cropping but the farmers applied, on average, only 0.43 bags/ha. Likewise, among the corn farmers, the average amount of Urea applied is 0.92 bags/ha while the recommended amount is 2.3 bags/ha. In BARMM, the PSA reported in 2020 that the average Urea application in 2014 was 1.31 bags per ha for rice and 1.00 bags per/ha for corn.
3.3. Profitability of marshland farming

3.3.1. Rice. Rice is the most common cereal crop in Pened, planted by 70.83% of the farmers, covering 15.4 hectares and planted once a year. Table 3 shows that the average total production cost per hectare is Php 7,032.27 which includes expenses for hired labor, fertilizer, and pesticides. Average yield is 1.57 t ha\(^{-1}\). Palay is sold at Php11.57 per kilo, letting farmers earn Php13,860.65 per hectare. With a 0.91 hectare average farm size per farmer, each farmer can earn about Php12,556.12 per year. Comparing this net return per farmer in Pened and the rice farmers in Nueva Ecija in Luzon, the difference is a little less than Php2,000. On the average (of high yielding and low yielding seasons), farmers in Nueva Ecija have gross earnings of Php15,769 per hectare. Unlike in Nueva Ecija where they can have two croppings, farmers in Pened plant only once since they have to consider the climate and the level of water. Nevertheless, cost of production in Pened is four times lower compared to latest available report of PSA-BARMM. The 2013 non-irrigated rice production cost in BARMM was Php 28,833.00 [32].

Furthermore, the cost of rice production in Pened is Php 4.50 per kg of palay. This is way lower than the cost of \textit{palay} production in irrigated areas in the Philippines (Php12.40) based on the study of IRRI in 2016. This is even lower than the cost of rice production in Vietnam which is at Php6.50 per kg [33]. The main reason is the farmers practically own the factors of production. Most farmers own the land they till, have available family labor, and the farmers do not impute a cost for factors of production that they own. They also do not spend for irrigation. Farmers practice minimum tillage system and do not rely heavily on external input. Table 4 shows that the farm input with the highest share of expenses is hired labor. Farmers spend Php 300.00 per farm labor per day. Two circumstances require hiring labor: non-ownership of a carabao and mouldboard plow and for chemical application. In the former, the hired labor owns the draft animal and plow and prepares the field for planting. On average, farmers spend Php4,177.53 per hectare for labor or 59.41% of the total production cost. This is the same in the rice producing province of Nueva Ecija where labor cost is the highest. For the cost of chemicals, Pened farmers spend Php1,811.82 (16.8% of production cost) while seeds cost Php 953.33 per ha (13.6% of production cost). Expenses for fertilizer only cost farmers Php 719.48 or 10.2% of production cost. This is due to the natural fertility of the soil where only 6 of the 17 rice farmers needed to apply fertilizer. Soil laboratory analysis in the area shows that the soil pH level is in a range suitable for most type of crops; it is rich in organic matter content; and it is high in Phosphorus (P) and Potassium (K). It is only in Nitrogen (N) where it is wanting.

3.3.2. Corn. Aside from rice, 12 farmers also plant white corn which is usually an alternate after planting rice. Farmers practice crop rotation – a farm management practice where various crop species are grown one after another. It is a mechanism for building healthy soils, a major way to control pests,
and a variety of other benefits [34]. As shown in Table 3, the average total corn production cost is Php4,333 per hectare including labor, fertilizer, and pesticides. With an average farmlot of 1.7 hectare per farmer, each of them spends an average Php 7,493 per cropping. The average market price of corn grain is Php13.94 per kilo which gives farmers an income of Php 3,933.56 per hectare. Table 4 also shows that out of the Php 4,333.40 total production cost per hectare, highest percentage is for hired labor (53.75%) amounting to Php2, 328.92. This is followed by cost of fertilizer application (22.8%), and chemical cost (15.6%). Only 50% of the farmers applied fertilizer. All of the farmers, however, used chemicals for their farms. These are mostly herbicides as substitute for manual weeding. Farmers spend least on seeds (7.9%) since many of them used second generation seeds or those seeds selected from previous harvest. The current cost of production in Pened is way lower than the production cost reported by [32] which was Php13, 579 which is traceable to the extensive use of external inputs such as seeds, fertilizer, pesticides, and farm mechanization.

3.3.3. Mungbean. Compared to rice and corn, there are fewer Pened farmers who plant mungbean. Mungbeans are planted during dry season and usually an alternate to rice. The average farm size is only 0.55 ha. As presented in Table 3, the average production cost is very minimal. Farmers spend only Php 1,1892.08 per hectare with an average yield per hectare of 0.32 t ha\(^{-1}\). Interestingly, the selling price is way higher compared to rice and corn at Php40.60 per kilo. With the cost of production and yield, the farmers spend Php 5.94 in producing a kilo of mungbean. The average net income per farmer is Php12, 898.83 per hectare per cropping. This is comparable to net income from rice per hectare, despite the smaller yield, and way higher than net income from corn. With 0.55 ha average farm size, farmers earn Php 7, 094 per cropping. Despite the suitability of mungbeans, farmers plant in only small portion due to the difficulty in weeding the farmlots. Farmers explained that mungbeans are sensitive to herbicides such that they usually have to do manual weeding. In addition, mungbeans are planted mostly during a long drought when planting corn and rice is not feasible. This is also practiced in Pakistan and Uzbekistan where mungbean is planted as catch crop for dryland systems and as alternate for wheat and rice [35]. Table 4 shows that more than half of cost of production for mungbean is on chemical cost and 41.46% is for hired labor. Farmers use their own seeds which are usually harvested from the previous cropping. They do not apply fertilizer, relying on the natural fertility of the soil.

| Table 3. Profitability of rice, corn, and mungbean in Pened, Kabuntalan, Maguindanao. |
|-------------------|----------------|----------------|----------------|
| Indicators        | Rice           | Corn           | Mungbean       |
| Number of Farmers | 17             | 12             | 8              |
| Average farm size per farmer (ha) | 0.91 | 1.31 | 0.55 |
| Ave. Total Production Cost per ha (Php) | 7,032.27 | 5709.08 | 1892.08 |
| Average Yield per ha (ton) | 1.57 | 0.78 | 0.32 |
| Average Market Price per kg (Php) | 11.59 | 13.94 | 40.64 |
| Average cost of production per kilo | 4.48 | 7.24 | 5.94 |
| Ave. Net Income per ha | 13,860.65 | 3,933.56 | 12898.83 |

| Table 4. Cost of production (cash outlay) per hectare in Pened, Kabuntalan, Maguindanao. |
|-------------------|----------------|----------------|----------------|
| Cost of Production per hectare | Rice | Corn | Mungbean |
| Cost | % | Cost | % | Cost | % |
| Hired labor | 4,177.53 | 59.41 | 2,328.92 | 53.75 | 784.39 | 41.46 |
| Seeds | 953.44 | 13.56 | 343.61 | 7.93 | - | - |
| Fertilizer | 719.48 | 10.23 | 986.65 | 22.77 | - | - |
| Chemical Cost | 1,181.82 | 16.81 | 674.22 | 15.56 | 1107.7 | 58.54 |
| Total | 7,032.27 | - | 4,333.40 | - | 1892.08 | - |
3.3.4 Recent efforts in diversifying livelihoods
Households maintain small vegetable plots for consumption but the visit of local traders to Pened in search of vegetables to buy for reselling prompted the farmers to plant vegetables on a semi-commercial scale in the first quarter of 2020. Farmers also thought of it as a possible means to mitigate losses incurred by farmers in their rice and corn production in 2018 and 2019. These traders consolidated the vegetable harvests for selling in a public market in the region. The farmers observed the less laboriousness of vegetable farming and requires lower production costs, and therefore more profitable. Pened then joined the nearby barangays in selling vegetables to at least five local government units which distributed the vegetables as part of relief goods during the early months of the COVID-19 pandemic. But some vegetable plots, together with rice and corn farmlands, were again damaged by the floods in June 2020. There were still standing crops in more elevated farms until August but these, too, were damaged in September.
Nonfarm sources of income are hard to come by in marshlands, and this is true also in Pened. The lack of access to a formal credit mechanism leaves them incapable to invest in other sources of income or to scale up production during more auspicious circumstances, resulting in vast idle lands. Moreover, the Pened farmers reported the lack of subsidies from the local government unit despite droughts or flooding.

4. Conclusion and recommendation

4.1. Conclusion
Farming in marshland areas can be considered as limited-resource farming. Expenses for farm inputs as seeds, fertilizers and pesticides are very minimal. Though farm yield is minimal, profitability is still comparable to those in other areas or regions in the country owing to the low production cost. Unpaid family labor, an informal subsidy to the cropping process, has practically zero opportunity cost owing to the lack of employment opportunities in the area. While farmers earn low from the farm’s produce, farmers have the capacity to finance their farming activity which makes the farm less dependent on external input. Farming approaches in the marshland can be considered as low external input agriculture (LEIA). This concept refers to reduced use of inputs outside the production system. Farmers do not completely eliminate the use of fertilizers and pesticides but only do minimal application. There is still a potential in improving this marshland farming system given the fertility of the soil and the use of traditional varieties adaptable in the area to attain optimum yield and profit. Diversifying crops to include more vegetables, which can be planted year-round have recently been found to be an additional source of income. Nevertheless, the uncertainty of weather has been rendering precarious the marshland livelihoods.

4.2. Recommendations
Pened farmers need to allocate more farmlots to mungbean as it has been found to be high-yielding and sells at a higher price. Similarly, the planting of fast-growing vegetables for the market can be regularly done, specially that there is a steady demand for it. The fertility of the soil, as proved by laboratory tests, is form part of natural capital that the Pened farmers can put to optimum use. While the soil has been found to be Nitrogen-deficient, this can be remedied by green manuring or the planting of leguminous crops such as peanut and soybeans, in addition to the planting of mungbeans, after harvesting either corn or rice. If commercial fertilizer cannot be avoided, farmers must follow the recommended amount of fertilizers based on the soil laboratory result. Organic fertilizers, however, are recommended.
During the flooding season, more elevated lands can be cultivated, to still allow some cropping. While fishing is the main source of livelihood during flooding, duck-raising can also be explored, given the need for a diversified livelihood system in the marshland that can work during both the dry and the wet season. Duck-raising can be started for small-scale commerce initially but it can later be scaled up especially that the marsh provides natural feeds including snails and shells. Some households reportedly raised ducks previously, but this has not been investigated deeply by this study. Financial capital is a concern to be able to avail of fishing gears, and duck-raising is expected to
require also some technical and financial assistance. A farmers’ organization can be formed by the Pened farmers themselves, utilizing some help from a university in the region which is engaging in extension services (which is now required of universities); the university can also render some technical assistance and can help forge stronger links between the farmers and the local government units and concerned local offices of national agencies. The strengthened networks will go a long way in assisting farmers in their livelihood endeavors both during dry and wet months.

5. References

[1] Elliot L, Mulamoottil G. Agricultural and marsh land uses on walpole island: profit comparisons. Canadian Water Resources Journal. 1992;17(2):111-119.

[2] Verhoeven J, Setter T. Agricultural use of wetlands: opportunities and limitations. Annals of Botany. 2009;105(1):155-163.

[3] Society N. wetland [Internet]. National Geographic Society. 2021 [cited 29 January 2021]. Available from: https://www.nationalgeographic.org/encyclopedia/wetland

[4] NEDA XII. Liguasan Marsh Development Master Plan: 1999-2025. Cotabato : s.n., 1998.

[5] The Ramsar Convention on Wetlands. Wetlands and agriculture: partners for growth [Internet]. Gland, Switzerland: The Ramsar Convention on Wetlands; 2014 p. 2. Available from: https://www.ramsar.org/sites/default/files/wwd14_leaflet_en.pdf

[6] Why are Wetlands Important? | US EPA [Internet]. US EPA. 2021 [cited 10 March 2021]. Available from: https://www.epa.gov/wetlands/why-are-wetlands-important

[7] McCartney, Matthew, et al. Wetlands, Agriculture, and Poverty Reduction. Colombo, Sri Lanka : International Water Management Institute, 2010.

[8] East African species introductions and wetland management:socio-political dimensions. Bugenyi, F. W. B. and Balirwa, J. S. Gainesville , USA : CUniversity Press of Florida Gainesville , 2003, Vol. 2003

[9] Hoanh, Chu Thai, et al. Irrigation in the Lower Mekong Basin Countries: The Beginning of a New Era? London : Earthscan, 2009.

[10] Sinolinding H, Porciuncula F, Corpuz O. Conservation of Ligawasan Marsh in Mindanao, Philippines, Through an Indigenous Knowledge System: Climate Change Mitigation and Disaster Risk Management. 2021.

[11] Commonwealth of Massachusetts Farming in Wetland Resource Areas: A Guide to Agriculture and the Massachusetts Wetlands Protection ActBelchertownCommonwealth of Massachusetts1996

[12] FPE. Marshals of the Marsh: Ligawasan Marsh. Davao City, Philippines : Foundation for the Philippine Environment, 2014.

[13] MacDonald, Stuart and Headlam, Nicola. Research Methods Handbook. Introductory guide to research methods for social research. Manchester : Centre for Local Economic Strategies, n.d.

[14] Statistical Services Centre. Approaches to the analysis of data. UK : Statistical Services Centre, The University of Reading, 2001.

[15] Local Government Unit-Kabuntalan. Comprehensive Development Plan of Kabuntalan, Maguindanao. 2010.

[16] Lobell D, Cassman K, Field C. Crop Yield Gaps: Their Importance, Magnitudes, and Causes. Annual Review of Environment and Resources. 2009;34(1):179-204.

[17] Powell J. Proceedings of the UK Organic Research 2002 Conference. Aberystwyth: Organic Centre Wales, Institute of Rural Studies, University of Wales, Aberystwyth; 2003.

[18] SAGIT and GRDC. Farm Gross Margin and Enterprise Planning Guide. Australia : Grains Research and Development Corporation, 2013.

[19] Barangay Local Government Unit of Pened. Barangay Development Plan through Participatory Rural Appraisal Kabuntalan2012

[20] PSA. 2013 Costs and Returns of Corn Production. Quezon City : Philippine Statistics Authority, 2014.
[21] Saiyut P, Bunyasiri I, Sirisupluxana P, Mahathanaseth I. Changing age structure and input substitutability in the Thai agricultural sector. Kasetsart Journal of Social Sciences. 2017;38(3):259-263.

[22] HelpAge International. The ageing of rural populations: [Internet]. London, UK: HelpAge International; 2021. Available from: https://www.helpage.org/silo/files/the-ageing-of-rural-populations-evidence-on-older-farmers-in-low-and-middle-income-countries.pdf

[23] Palis F. Aging Filipino rice farmers and their aspirations for their children. Philippine Journal of Science [Internet]. 2020 [cited 10 February 2021];149(2):351-361. Available from: https://philjournalsci.dost.gov.ph/images/pdf/pjs_pdf/vol149no2/aging_filipino_rice_farmers_.pdf

[24] The Role of Gender in Agricultural Productivity in the Philippines: The Average Treatment Effect. Koirala, Krishna H., Mishra, Ashok K and Mohanty, Samarendra. Atlanta : Southern Agricultural Economics Association, 2014. 2015 Annual Meeting, January 31-February 3, 2015.

[25] Women’s empowerment and gender equity in agriculture: A different perspective from Southeast Asia. Akter, Sonia, et al. 2017, Elsevier Ltd, pp. 270-279.

[26] Agro-morphological Characteristics of Local Upland Rice in Arakan Valley, Cotabato, Philippines. Bangi, Juliet P. Candog, Polido, Mary Ann Robelle L. and Aquino, Vermando M. 2019, International Journal of Humanities and Social Sciences, pp. 21-32.

[27] Enhancement of Upland Rice Production in Various Agro-Ecosystems. Corpuz, Onofre S., et al. 2015, American Journal of Agriculture and Forestry, pp. 30-34.

[28] The floating traditional rice techno-demonstration for community food security. Buisan, Pasigan U. and Buisan, Nasrudin A. 2019, International Journal of Agricultural Extension, pp. 09-11.

[29] Rabara R, Ferrer M, Diaz C, Newingham M, Romero G. Phenotypic Diversity of Farmers’ Traditional Rice Varieties in the Philippines. Agronomy. 2014;4(2):217-241.

[30] PSA. Selected Statistics on Agriculture (SSA). Quezon City : Philippine Statistics Authority, 2019.

[31] Buisan N, Liwayway V. Development initiatives for development and protection of Liguasan Marsh, Southern Philippines. Cotabato, Philippines; p. 10-50.

[32] ——. Costs and Returns Survey (CRS) of Palay Production. Quezon City : PSA, 2015.

[33] Bordey, F H, et al. Competitiveness of Philippine Rice in Asia. Munos : Philippine Rice Research Institute and International Rice Research Institute, 2016.

[34] Mohler, Charles L. and Johnson, Sue Ellen. Crop Rotation on Organic Farms: A Planning Manual. Brentwood : Sustainable Agriculture Research and Education (SARE), 2020.

[35] Mungbean as a catch crop for dryland systems in Pakistan and Uzbekistan: A situational analysis. Rani, Saima, Schreinemachers, Pepijn and Kuziyev, Bakhodir. 2018, Cogent Food & Agriculture, pp. 1-15

Acknowledgments
The authors acknowledge the assistance provided by the Commission on Higher Education (CHED) and Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).