Understanding right, the productivity (yield) of coconut from the Philippines’ Research and Field Experience: A knowledge tool for industry development and management (A research notes)

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ABSTRACT

In the past and till today, it is not uncommon to read, and hear individuals, interest groups and commercial sectors in favor of either coconut farming or oil palm production, depending on ones inclination and extent of available hard facts of these perennial tropical oil crops. Any deficient or wrong knowledge will eventually end up with costly decisions and economic imbalance and dislocations of rural and urban communities in the country, with at least 50% of the country’s populace directly or indirectly depend on the coconut industry for business and/or livelihood, economic-wise.

Because of this knowledge gap, the author had attempted to prepare a research notes as an IEC material on knowing better the potential, achievable, average and statistical mean national yield based on available reported data. Indeed the agro-biological efficiency of oil palm crop is higher than that of coconut palm but if growing conditions and farming practices are not growth or yield-limiting in both crops, very likely a synergized and focused production strategy could maximize a sustained supply of both oil crops in the immediate and long term periods in the country, achieving both sufficiency and sustainability in these closely related crops in many uses.

Keywords: coconut palm tree; oil palm crop; nut yield; copra yield; coconut oil, palm oil; productivity of tropical perennial oil crops.

Significance, importance and relevant background

The productivity of coconut palm crop (Cocos nucifera L.) one of two main perennial tropical oil crops grown in Southeast Asia, particularly the Philippines (3.5 Mn ha) and Indonesia (3.7 Mn ha) appears unclear or not well understood by many, locally and globally. In fact, recently there were reports or statements that clearly indicates that some business executives of the coconut industry, and influential leaders in the government strongly mentioned that coconut development does not deserves national (government/public policy support and investment of funds) mainly due to its low productivity or crop yield per unit land over time, compared to oil palm crop (Elaeis guineensis, Jacq., the other
tropical oil crop grown widely in Southeast Asia, particularly Malaysia (5.5Mn ha) and Indonesia (2.1 Mn ha). It is a fact that plantings of coconut palm trees in the Philippines occupies about 30% of agricultural lands in the country, while plantings of oil palms in Malaysia, 66% of its agricultural lands.

This PCA consultant noted two instances of intensely disturbing, negative statements against the growing or rehabilitation of the coconut crop in the country. The first case: in mid year 2013, in the CIIF-OMG HERALD Newsletter, June 2013), where no less than the President and CEO of CIIF Mills Group pointed out in the said newsletter issue: “As a production reference, a hectare of oil palm plantation produces 5 metric tons (mt) of palm oil while a hectare of coconut plantation produces only less than 1 mt (600 kilograms).” The information source and under what growing conditions such findings on crops’ productivity (oil yield) were obtained for oil palm and coconut crops was not indicated. While in the second case: a very recent news article, “No new coconut trees for Yolanda-hit areas”, business reporter, Ms Kristyn Nika M. Lazo (Manila times, February 2014), cited the statement of Finance Secretary Cesar Purisima from a very recent investment forum that he said “that the government is no longer keen on replanting coconut trees in the areas hit by Yolanda because earnings from coconut is no longer profitable”. Moreover, it was also mentioned in the same news item “that small farmers only produce copra, mostly bought by oil millers for the domestic and local market” How this matter is linked with productivity is unclear, because with higher productivity or yield of nuts, converted to copra, with the current high copra price of (Php 35-38/kg of copra) at good annual yield of at least 2,000 kg copra per ha this is valued at an average of PhP73,000 total income, less the production cost of PhP15,000/ha, provides a small farmer with PhP58,000 per ha, for coconut trees alone (monocrop). Thus, this indicates, high coconut productivity or nut yield commonly results in high profitability, under an economic situation of high copra price. Hence, farmers should always aim for high achievable yield of coconut (with at least moderate to sub-optimum fertilization).

The PCA’s findings (2010) revealed a coconut annual productivity per ha with moderate fertilizer application of coconut trees in a monocropping system (only coconut grown) usually achieved a fairly good yield of 8,000 nuts/ha (equivalent to 2 tons copra). This provides an annual net return (economic income of PhP21,050 (PhP15/kg copra); but considerably improves under coconut intercropping systems (coconut plus selected intercrops: e.g., corn intercrop (5 tons, 2croppings a year, @ PhP7/kg corn = PhP 42,950); and with ‘Saba’ banana intercrop (5 years cropping cycle) with average of P72,905/ha, annual total land productivity.

In an earlier study (UPLB and PCA (2002) cited by Magat (2008), it revealed that with a production system of producing coconut for copra (dried coconut meat or kernel, with 12% moisture or lower), the total economic benefits (total economic value of coconut from both: (1) food/nutrition uses and (2) environmental services or functions amounts to an average of P198,000/ha, annually, and with hybrid coconut up to PhP 223,800, mainly attributed to its higher nut and copra yields over tall and dwarf varieties. Thus, when environmental services of coconut as soil conservation, farm diversification nutrient recycling and carbon storage and fuel energy (coconut methyl ester or CME), on top of food applications and nutrition uses are included to determine the total value of coconut trees to the country, clearly the value of coconut is upgraded 10 times. This significantly high economic benefits is not commonly achievable in agricultural crops. Coconut is clearly a multi-function crop with almost unlimited uses in food security, agriculture and environmental purposes, shelter and biomass-energy.
This technical presentation is an unbiased attempt to contribute in our understanding of the agro-biological efficiency, i.e., the productivity or yield of oil crops, particularly tropical perennial plant oils: oil palm and coconut palm, both grown in many tropical countries as Philippines, Malaysia, Indonesia and Thailand.

Productivity or yield is a direct measure or index of the efficiency of a crop to produce its harvest output per tree or per unit land area (ha) over a specific period (year). In the coconut crop, these are expressed as nut yield or copra yield per tree or per ha (planting population depends on field spacing and arrangement). Potential yield (PY) is highest productivity reached under ideal growing conditions (seldom reached) while, achievable yield (AY) the highest yield obtained with use of best/good farming practices, including judicious or optimum crop nutrition and fertilization management. On the other hand average yield (AVY) is the productivity of coconut farms with low to moderate level of farm inputs, and the national average yield (NY) the average statistical yield estimate based on a nationwide coverage of most of the representative or sample coconut farms (from small, medium to big scale). In the Philippines, the national average yield in a reference year is always low over the past decades which had been attributed mainly to the fact that over 85% of farms are with farm size of 2 ha or less extensively follow the natural farming system with very low adoption level of proper farming practices, with annual fertilization very inadequate and irregular. This situation therefore, is in strong contrast with commercial oil palm farming, where regular and location-specific fertilization is a strictly followed to obtain economic yields (central role of fertilizers in oil palm production), with fertilizer cost amounting to more than 50% of the annual regular production cost in commercial oil palm production (Thomas Fairhurst, 1998).

Coconut Palm Yields in different countries (J.G. Ohler and S.S. Magat, 2001)

Worldwide, small-scale farms or smallholder plantations usually yield between 0.5 – 1 ton copra/ha/year. In Malaysia, annual average estate yields are about 1.5 t of copra, but the potential yield is about 3.5 t/ha. In Indonesia well managed plantations of selected tall varieties yield 3.5-4.5 t copra/ha/year. While in the Philippines, rehabilitated coconut palms in small farms with at three-years of fertilization of inorganic mineral fertilizers achieved annual yield of 2.8 t copra/ha or 83 nuts/tree/yr from baseline yield of 35 nuts/tree. Potential yields of 6-9 tons copra have been obtained in the Ivory Coast (West Africa) and Philippines with optimum nutrition and judicious fertilizer applications, in years of very adequate and well distributed monthly rainfall.

There is a wide range of achievable nut and copra yields in the Philippines, depending on the coconut variety and planting materials observed in government research stations and farmers fields (Table 1). Also in the same table, with almost optimum nutrition in PCA research stations, nut yields/ha/yr (143 palms/ha) of 14,600 and 18,900nuts, tall and coconut hybrids were obtained. In copra terms: 4.25t/ha and 5.25 t/ha, respectively, and these are equivalent to 2.67 and 3.31 tons oil/ha/year, respectively. Moreover, even moderate level (sub-optimum) fertilizer application increased achievable annual yields in small farms (SCFDP): 1.02 t copra (no fertilizer) to 2.79 t copra/ha (with 3-year fertilizers) or 0.98 t oil (no fertilizer) to 1.80 t oil/ha (with 3-year fertilizers). Clearly, with proper application of fertilizers to coconut trees, nut, copra and oil yields are increased to high productivity and profitable levels, up to 3 times the average or national yield levels. Clearly and obviously, this is in high contrast to the perceived low productivity and profitability of coconut trees in the country, of the poorly informed government and coconut industry top
executives. Indeed, the right science and scientific facts are the best tools in developing and sustaining the coconut industry growth.

Table 1. Relevant findings on the annual average achievable yields of coconut under different varieties and planting materials under good farming practices with adequate nutrition to sub-optimum (fertilization).

<table>
<thead>
<tr>
<th>Yield Index</th>
<th>Talls (@143 trees/ha)</th>
<th>Dwarfs (@180 trees/ha)</th>
<th>PCA hybrids (@143 palms/ha)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuts/ha</td>
<td>14,600</td>
<td>21,200</td>
<td>18,900</td>
<td>Research stations</td>
</tr>
<tr>
<td>Copra/ha (t)</td>
<td>4.25</td>
<td>4.7</td>
<td>5.25</td>
<td>Genetic trial blocks @ PCA-ZRC</td>
</tr>
<tr>
<td>Oil/ha (t)</td>
<td>2.67</td>
<td>2.95</td>
<td>3.31</td>
<td>63% oil basis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remarks</th>
<th>Local Talls</th>
</tr>
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<tbody>
<tr>
<td>W/o fertilizer</td>
<td>With fertilizers (3 years regular)</td>
</tr>
<tr>
<td>Research stations:</td>
<td>Laguna Tall variety</td>
</tr>
<tr>
<td>Nut/tree</td>
<td>63</td>
</tr>
<tr>
<td>Copra/ha</td>
<td>1.57</td>
</tr>
<tr>
<td>Oil/ha</td>
<td>0.98</td>
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</tbody>
</table>

SCFDP Farms* (1990 - 95): Widely Laguna Tall variety
| Nut/tree | 35 | 83 |
| Copra/ha | 1.02 | 2.79 |
| Oil/ha | 0.64 | 1.80 |

Source: PCA- Zamboanga Research Center (Breeding and Genetics, 2005); Good Agricultural Practices-Coconut (Magat, 2006 and 2008)* total of 350,000 ha (200,000 small-scale farms) covered by the Small Coconut Farms Dev. Project, World Bank-Assisted.

Oil Palm Crop Yields in Different Countries (J.J. Hardon, N. Rajanaidu and H.A.M. van der Vossen (2001))

In the production year 2000, the world average annual oil yields of oil palm crop per ha was 3.3 t palm oil (PO) plus 0.8 palm kernel oil (PKO, a component plant oil similar to coconut in fatty acid composition). PKO normally contains 45% oil and 55% PKO meal residue (by-product). The national yield averages (combined private and government estates plantations and smallholders farms) for palm oil annual yields per ha are 4.1t oil in Papua New Guinea, 3.8 t in Columbia and Malaysia, 3.3 t in Indonesia and 2.9 t in Ivory Coast, West Africa. Oil palm crop, globally of the commercial (‘Dura x Pisifera’ or tenera

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(hybrid) planting material is highly responsive to environmental conditions and agronomic practices (e.g., optimum nutrition/judicious fertilization), thus achievable yields are high and vary widely.

In well-managed mature plantations in Malaysia, Indonesia and Papua New Guinea annual fresh fruit bunch (FFB) yields of 24-32 t/ha are common, and with the PO mill extraction rate of 22% oil (tenera hybrid fruit type), these FBB yield 5.3 – 7 t oil /ha.

Under well managed conditions of a hectare land (@143 palms (9m x 9m in triangular planting), the achievable annual yields of OP tenera hybrids) of 25 t FFB/ha or 5.8 t oil compared to coconut at annual yield of 14,500 nuts/ha (selected tall variety), @ 4.0 tons copra) = 2.5 t oil/ha. This indicates that at best achievable oil yields of the two tropical perennial oil crops, oil palm and coconut, the yield or productivity advantage of oil palm over the coconut crop is estimated to be about 2.3 times and not 5 times or higher as claimed by people or groups seemingly unsupportive of coconut industry development in the country. Such difference supports the scientific facts that oil palm crop which naturally produces more leaves annually, thus more fruit bunches has inherently higher biological efficiency than the coconut palm tree. This means the coconut crop has a lower efficiency in converting the solar energy and essential plant resources to the plant oil and other primary products of the oil crop. However, in general it is well known that coconut tree (fruits/nuts and other component parts) has a much wider spectrum of food and nutrition uses/products as well as its unique environmental services or functions serving both the needs of developing and developed countries

Concluding Notes

1. The agro-biological efficiencies of the two tropical perennial oil crops -------- oil palm and coconut palm considerably differs, with the oil palm inherently higher than the coconut. The following attributes (Table 2) clearly indicates the significant difference between the two oil crops. Hence, under similar desirable growing conditions with best management practices (BMP) or good agricultural practices (GAP), inherently, due to the higher biological efficiency nature of the oil palm crop, its yields will always be higher than coconut palm, a crop which nevertheless widely suits the socio-economic profile or needs of most resource-limited small farms in the country.

Table 2. The biological efficiency attributes of oil palm and coconut crops.

<table>
<thead>
<tr>
<th>Agro-biological Index</th>
<th>Oil Palm</th>
<th>Coconut Palm</th>
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<tbody>
<tr>
<td>Leaf Production (per year)</td>
<td>Tree crown with 36- 48 green leaves (40 leaves maintained); 20-24 leaves per yr (full bearing); leaf remains biologically active for about 2 years</td>
<td>Tree crown with 30-35 green leaves. Talls- 12 leaves/yr; hybrids –18 leaves/yr; dwarf – 20-22 leaves/yr; leaves remain active for 2.5 years from leaf emergence</td>
</tr>
<tr>
<td>Fruit/nut maturity</td>
<td>4.5-6 months after anthesis or flowering; ripe fruits become</td>
<td>Tall varieties – male and female active phases do not overlap; in</td>
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detached from fruit bunch; oil formation in fruit seed (kernel) takes place 2.5 -3.5 months from flower pollination and in the mesocarp (pulp), later at 4 months.

dwarfs--- this overlaps or with self pollination (reason for its inbred or dwarf integrity); 50 -70% of female flowers (buttons) abort during first two months due to poor pollination and other physiological causes. Nut bunch matures in 11-12 months from complete pollination (male pollen fertilizing female flowers)

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<tr>
<th>Harvesting frequency/interval</th>
<th>Bunches ripen throughout the year and harvest rounds usually at intervals of 7-10 days, when optimum degree of ripeness reached (5 detached fruits seen on the ground – first 3 years of fruiting; 10 fruits fall, older palm or 4 years and onwards.</th>
<th>Talls and hybrids - mature nuts can be harvested in 11-12 months after perfect pollination of female flowers. Coconut trees can be harvested every 2-3 months. Rapidly germinating varieties (still on hanging bunches) should be harvested earlier. Harvesting every 45-60 days interval (8-6 harvest rounds per year), with usually 1-2 harvestable bunches each tree) could be practical and more economic.</th>
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<tbody>
<tr>
<td>Productive-economic life time</td>
<td>25 years (after which, replanting is practiced as it is uneconomic to harvest very tall palms with declining FFB yield.</td>
<td>50 -70 years, depending on the variety, nutrient/soil management and current annual yield of nuts and or copra (PCA yield estimation method). Coastal coconuts still productive beyond 60 years.</td>
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</tbody>
</table>

2. Immediate oil milling requirement of freshly harvested fruit bunches of oil palm - In contrast to dried coconut kernel (copra with 6 -12 % moisture) which can be stored for a considerable time, harvested FFB of oil palm crop have to be taken to the oil mill within the next 24 hours for steam sterilization in order to deactivate the enzyme lipase and kill all micro-organisms in the wet fruit mesocarp. This is a must to prevent the rapid rise in free fatty acid content and general degradation of the palm oil extracted from the fruit pulp. Together with oil mill assembly, the development cost covering plantation roads connected to the oil mill, adequate electricity and good water source and transport/delivery system in a nucleus estate setup are of huge investment cost in oil palm production. Thus, OP plantation must optimize oil yield to be in commercial business.

3. Oil palm Farm maintenance practices are strictly followed to achieve high target production output for high profitability (least production cost per kg oil). The required maintenance practices done without delay are: weeding, fertilization, pruning of leaves (to maintain 40 leaves at any time) and cleaning of harvesting paths. As such, in Malaysia, it requires 1 farm worker for every 4 ha oil palm land, but 10-12 ha per worker becoming common due to increasing labor cost and shortage. While in
the Philippines, the coconut farmers or farm workers only stays 60-70 days/ha a year, in sole coconut cropping or 100 -150 days/a each year if a farm practices intercropping (diversified farming with low capital inputs, limited improved practices applied and tasks done extensively manual). This means that coconut farmers, depending on their socio-economic profile and life-styles are still involved in other economic or livelihood activities during the year.

4. Coconut is largely a small-holders’s crop. Nut harvesting and all post-harvest handling are done manually. The nuts are left to dry in a shaded place. Husked and opened nuts are dried in a smoke /kiln or hot-air dryer (indirect heat), partially dried copra (kernel) removed from shell and further dried to 6% moisture. This indicates, timing of operations in coconut farming more flexible than in OP production.

5. Even as early as 2000, Malaysia achieved 10.70 Mn tons of palm oil (PO) plus 1.42 Mn tons of palm kernel oil (PKO), its complementary plant oil, very similar to coconut oil from its 2.91 Mn oil palm (OP) lands. In the same year, the Philippines produced only 1.60 Mn tons oil from its 3.1 Mn ha coconut lands earlier in 2000. Indeed, an immense global progress had been achieved in Malaysia, the biggest palm oil producer, in responding to high global demand for plant oils. This is a clear indication of the weakness of Philippines in demonstrating its capability to be a reliable supplier of coconut oil as a result of very low average crop productivity (yield) of coconut in the estimated 1.50 Mn coconut farms in the country due to decades-long very low and slow adoption of practical and effective fertilization technology.

6. The globally-known success of Malaysia in pushing its national level of annual OP production volume and productivity per or yield ha to a high average of 3.8 tons palm oil/yr of the widely planted OP Tenera hybrid (24-32 tons fresh fruit bunch/ha/yr) is strongly and extensively a result its annually monitored highly effective and efficient crop nutrition and fertilization management of the OP crop, with regular site-specific average annual application rate per OP bearing tree of 3-4 kg Nitrogen+ Phosphorus+ Potassium + Magnesium fertilizers plus micronutrients (Hordon, Rajanaidu, van der Vossen 2001). In this way, The achievable yield of oil palm crop is optimized, making it very attractive vegetable oil crop (reaching 2.5 – 3.5 times higher oil yield than coconut), when both crops following the best management practices, especially optimum nutrient management, or better still, an integrated soil fertility management (ISFM).

7. Finally, in using crop productivity as a major basis in supporting the industry development and sustainability of oil crops’ supply, it is not technically acceptable or technically flawed to compare annual achievable crops’ productivities (e.g. oil yield/ha) under different growing conditions. For instance, annually, 5 tons oil yield per ha of oil palm under best management practices, compared to 0.60 ton oil yield/ha of coconut under marginal farm management practices. With such defective evaluation, the obvious tendency is for one to have a strong conclusion supporting oil palm production, and thus, eventually discouraging monocrop coconut farming in the country, as what had been seemingly the state of minds of poorly informed decision makers and government executives. Science and Technology-wise, however, when both crops are supplied with adequate and balanced nutrition management (commonly, at 50% and 25 % of total annual production costs of mature bearing oil palm and coconut, respectively), and the resultant field productivity of each plant oil crop should be the most objective basis (solid facts) of productivity and profitability directions, thereby avoiding the risks of costly rural development investment and socio-economic dislocations of coconut-based communities. Moreover, with science and hard facts applied, a harmonized production and synergized
development of both tropical perennial oil crops in the Philippines is likely still within an achievable range.

Key References


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