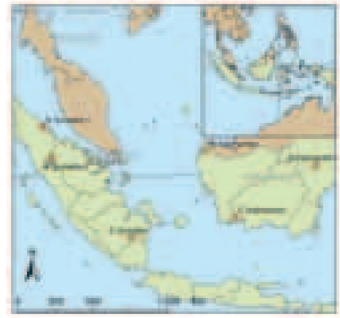
Yield Intensification in Oil Palm Plantations through Best Management Practice



By C.R. Donough, C. Witt, and T.H. Fairhurst

By comparison with the other major vegetable oil crops, oil palm occupies a small area but contributes about one-third of the global vegetable oil supply. Production has increased exponentially in the last 30 years, mainly through an expansion of the area planted. Meanwhile average yields have remained far below the economic yield potential. IPNI and its partners have developed a management concept to close existing yield gaps through best management practices (BMPs).

Planted area and production of palm oil have increased exponentially in Southeast Asia since the 1970s **(Figure 1)**. Indonesia and Malaysia, the largest producers, account for a combined share of 85% of global palm oil production. The potential productivity of oil palm is several times greater than that of other oil producing crops so that, provided the crop is managed properly, much less land is required to produce a quantum of vegetable oil compared with other vegetable oil crops.

Potential oil yield of oil palms planted on a commercial scale has been estimated at 10 to 11 t/ha (Breure, 2003). The largest reported oil yield at an estate scale (c. 2,000 ha) in Malaysia was more than 8 t/ha and leading plantation groups in Indonesia and Malaysia have achieved average oil yields of 6 t/ha at a larger scale (Donough et al., 2006). At an oil extraction rate of 22%, this would be equivalent to a bunch yield of about 27 t/ha. However, average bunch yield, even in the favorable environment in Southeast Asia, remains at less than 20 t/ha **(Figure 1)**.

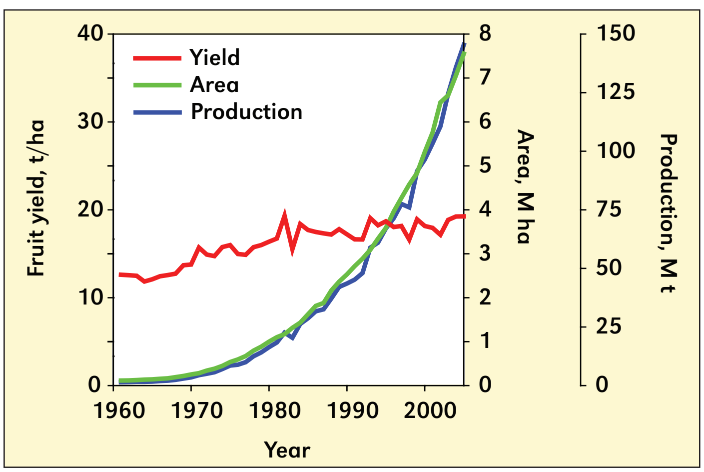


Figure 1. Yield, area, and production of palm oil fruits from 1961 to 2006. Source: FAOSTAT 2008.

Rationale for Yield Intensification

Oil palm responds rapidly to improvements in agronomic management with short term increases in bunch weight and longer term increases in bunch number both contributing to increased yield. There is a time lag of 3 to 4 years (i.e., the time interval between floral initiation and the production of a ripe bunch) between the removal of agronomic constraints and full impact on yield. For producers, the financial returns from investments in yield intensification in existing plantations are clearly more rapid and larger than returns on the development of new plantings for these reasons: 1) production starts to increase as soon as agronomic constraints are removed, and 2) yield intensification does not require capital outlay on new plantings and plantation infrastructure.

In addition, and provided BMPs are used, increasing yield on existing plantings has environmental benefits because production is increased while sparing wilderness land from agricultural development. A further impetus for yield intensification is the dwindling availability of suitable land for further expansion of oil palm plantings. With controls on land development tightening in Southeast Asia, future expansion is likely to focus on degraded land where development costs must allow for the amelioration of low fertility status soils.

For oil palm plantations, inputs are usually both available and affordable and estates obtain seed with high yield potential from certified seed producers. Thus, the key to improved yields is in better agronomic management and estate organization and planning. Yield improvement efforts in existing plantations must focus on identifying and rectifying management practices that contribute to the emergence of a gap between the maximum economic yield and actual yield **(Figure 2)**.

BMPs are well established and described. For example, note the series of handbooks and pocket guides published

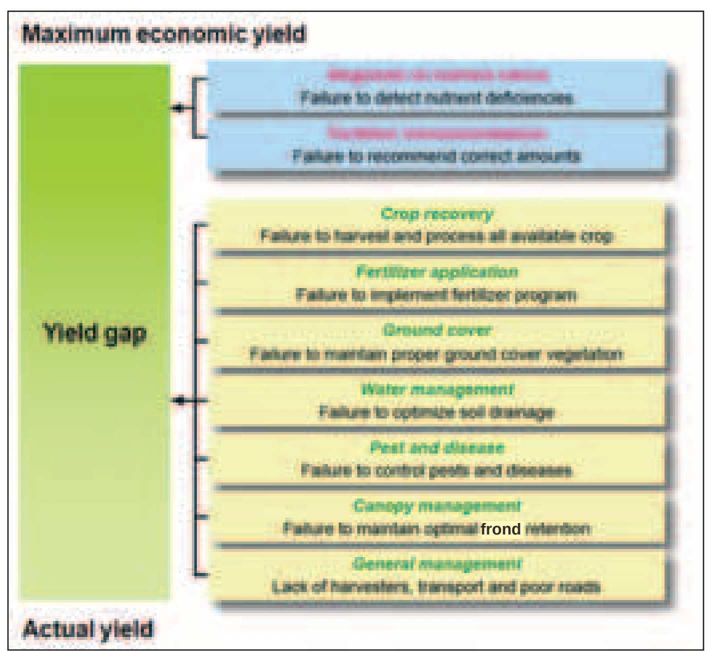


Figure 2. Management factors contributing to the gap between actual and maximum economic yield in existing oil palm plantations (after Fairhurst et al., 2006).

Abbreviations and notes for this article: M t = million metric tons.

by IPNI, available at: >**www.ipni.net/seasia**<. However, plantations often lack suitable methods to identify practices that could contribute most to yield improvement. The BMP concept promoted by IPNI is more than a description of the actual practices, it is a management tool to collect the necessary evidence on the potential for yield improvement before time and costly resources are allocated to expand practices within an estate (Fairhurst et al., 2009). In this article, we integrate yield intensification with environmental goals and define BMPs as follows:

BMPs are agronomic methods and techniques found to be the most cost effective and practical means to reduce the gap between actual and site yield potential and minimize the impact of the production system on the environment by using external inputs and production resources efficiently.

BMP as a Management Tool

IPNI has been instrumental in developing a BMP concept for yield intensification in existing mature plantings **(Figure 3)**. In this approach, a set of site-specific BMPs are identified and implemented in a representative number of full-size management blocks in each estate to achieve crop management objectives related to productivity, profitability, sustainability, and the environment. Through this process, estates identify better ways to implement BMPs for yield intensification, and decisions on larger investments in BMPs are based on practical, commercial-scale evidence. Performance indicators are selected to describe the complete impact of a combination of BMPs on all four crop management objectives while adhering to sustainable development goals.

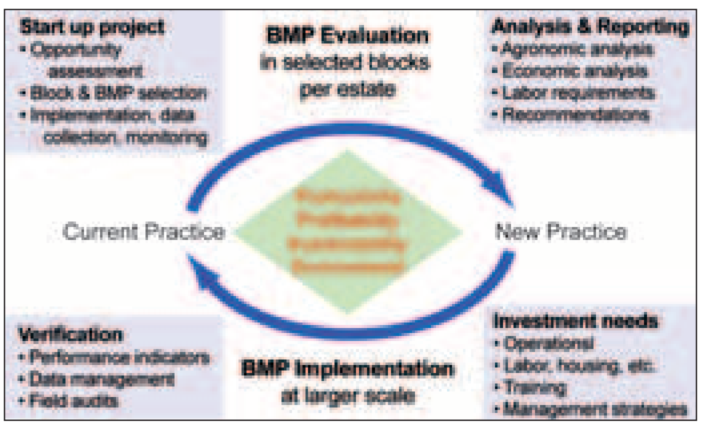


Figure 3. Conceptual framework for the evaluation of BMPs in mature oil palm plantations (after Witt and Donough, 2007).

The evaluation of BMPs is implemented by the estate management staff, and we emphasize the importance of involving key decision makers and resource persons in the local management team.

Once a new practice is successfully implemented at larger scale, it becomes current practice and the cycle of evaluation and implementation starts over again.

Evaluation of the BMP Concept

The BMP concept was first developed and successfully introduced in an oil palm rehabilitation project at PT Asiatic Persada in Jambi Province in Indonesia in 2001 (Griffiths and Fairhurst, 2003) before being implemented at larger scale in several other estates of CTP Holdings in Indonesia and Papua New Guinea (Fairhurst et al., 2006). In 2006, IPNI launched a new initiative to promote yield intensification based on generic principles of its BMP concept by setting up 30 commercial BMP blocks in partnership with collaborating plantations in Sumatra (North, South) and Kalimantan (West, Central, and East). Collaborating partners include Bakrie Sumatera Plantations (Site 1), Permata Hijau Group (Site 2), Wilmar International Limited (Sites 3 & 4), Sampoerna Agro Group (Site 5), and REA Kaltim Plantations (Site 6).

At each site, five pairs of blocks sized at least 25 ha were selected to represent the estate. One block was designated as the block for BMP implementation; the other became the reference (REF) block where current standard practices were maintained. BMPs were implemented based on the following priorities:

Priority 1 – Crop recovery
- Adopt a 7-day harvesting interval
- Maintain clean palm circles and clear access paths
- Construct harvesting platforms and harvesters' bridges
- Collect loose fruit in bags

Priority 2 – Canopy management
- Maintain proper pruning
- Remove abnormal and diseased palms
- Supply vacant planting points

Priority 3 – Soil, moisture, and nutrient management
- Maintain frond placement in inter-rows and between palms
- Apply empty fruit bunches
- Maintain fertilizer management to support large, profitable yields
- Construct adequate drainage

Projects at Site 5 and Site 6 have now completed at least one year of BMP implementation, while data for longer time periods is available from other sites (16 months for Sites 3 and 4; 22 months for Sites 1 and 2). Preliminary results are calculated on an annual basis **(Figure 4)**.

Prior to project implementation, fruit bunch (FB) yield was on average 1 t/ha greater in REF compared with candidate BMP blocks (data not shown). After 12 to 22 months of BMP implementation, yield was the same or greater in BMP compared with REF blocks at all six sites **(Figure 4a)**. On an individual block basis, higher FB yield was recorded post-implementation in 24 of 25 blocks with available pre-implementation records. There was no difference in yield between BMP and REF blocks at Site 1 where average yields were greatest amongst all project sites. It remains to be seen whether yields greater than 30 t/ha can be achieved with BMPs at Site 1 during the 4-year evaluation period. If not, attainable yield has been reached for the current palm stand.

The net added value with BMPs was significant at four out of six sites ranging from US$260 to 680/year **(Figure 4b)** based on actual cost and an assumed value of US$115/t fruit bunch yield. It is expected that BMP will become profitable at Site 6 once the full impact of BMP is expressed in yield and investments in drainage and other practices made in the first year are recovered in increased productivity.

The additional cost associated with the implementation of BMPs was relatively small, ranging from US$15 to 30/ha after 10 months (sites A, B). Yield advantages with BMP were

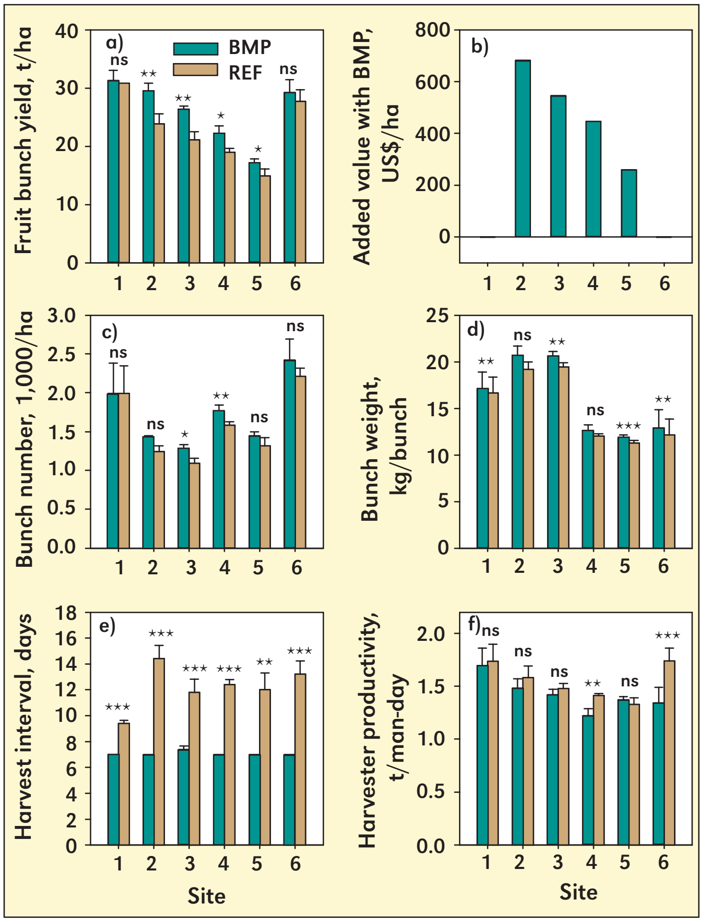


Figure 4. Performance of BMP in comparison to reference blocks (REF) at six project sites in Indonesia. Data represent a 12-month average, but the period of measurements ranged from 12 to 22 months.

generally due to improvements in both bunch number and bunch weight **(Figure 4c and 4d)**. Yield improvement in the first year of BMP implementation was largely attributed to improved crop recovery following the implementation of 7-day harvesting intervals, i.e., every palm is visited by harvesters once each week. The average harvesting interval in REF blocks was 12 days **(Figure 4e)**. Because of the short harvest intervals with less bunches to harvest per round, the daily area covered by harvesters was 15 to 35% greater within BMP blocks compared to the standard practice in REF blocks. However, because of the greater yield within BMP blocks, average harvester productivity based on the weight of the harvested fruit bunches per man-day was only 4 to 15% lower with BMP than REF **(Figure 4f)** while the number of harvested bunches was 10 to 20% lower in BMP (data not shown). As harvesters are paid based on the number of bunches harvested, productivity targets and payments will need to be reviewed so that harvesters benefit from the higher yield under BMPs. More harvesters are needed when following the BMP scheme, but the increased demand is not in direct proportion to the increased frequency of harvesting because each harvester covers a larger area per day when shorter harvesting intervals are maintained.

The project will continue until all sites have completed a 4-year cycle of yield improvement. Now that all BMP blocks have entered 'maintenance' mode, cost differences between the BMP and REF blocks will decrease, while the effects of other non-harvesting BMPs such as nutrient management are expected to provide further yield improvements compared to standard practices.

Conclusions

Encouraging yield improvements achieved through the implementation of BMPs at sites broadly representative of the oil palm industry underline the general applicability of the BMP concept. Clearly, a short harvesting interval and full crop recovery is a pre-requisite for closing current yield gaps at project sites. The next step in the yield intensification process will require a thorough analysis of the data at each site to determine the site-specific requirements for wider implementation of the selected BMPs. The BMP concept is consistent with Principle 4 (best practices) and Principle 8 (continuous improvement) of the Principles and Criteria for sustainable palm oil production of the Roundtable on Sustainable Palm Oil (RSPO, >**www.rspo.org**<). It should be noted that the success of a BMP project hinges on the commitment from senior management to provide direction as well as sufficient budget and resources, and from local estate management to implement the BMP(s) rigorously and on time. BC

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