Rice and narrowing the yield gap

- Most rice varieties are not achieving their potential yields. In many countries, actual yields are only about 4 to 6 tonnes/ha, compared with a potential of 10 to 11 tonnes/ha.
- There is also a gap between the maximum attainable and the farm-level yields, which ranges from 10 to 60 percent.
- The causes of rice yield gaps are related to biophysical factors, cultural practices, socio-economic conditions, institutional and policy thrusts, or levels of technology transfer and linkages.
- Narrowing yield gaps increases rice productivity, improves land and labour use, reduces production costs and increases sustainability.
- Participatory approaches, the promotion of integrated crop management and support from government policy are among the strategies that need to be adopted in order to narrow yield gaps.

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rice is life

THE SITUATION

Most existing rice varieties, particularly modern varieties and hybrids, have a potential yield that is higher than the actual yield, and there is considerable variation in the actual yield levels achieved, even under similar production systems. In many developing countries, yields of irrigated rice are only about 4 to 6 tonnes/ha, while the potential yield of modern rice varieties is 10 to 11 tonnes/ha under tropical humid conditions. At the field level, yield differences among farmers in the same area are frequently observed because of farmers' different levels of crop management and the diversity of environments in the area. In addition, progressive farmers usually obtain higher yields and more profits than ordinary farmers, indicating the existence of knowledge gaps.

The Expert Consultation on Yield Gap and Productivity Decline in Rice Production, convened by FAO in Rome in 2000, recognized that there is a sizeable yield gap between attainable and farm-level yields across the ecologies, the regions, within ecologies and the crop seasons in many rice-growing countries (Table 1). The yield gap between attainable and farm-level yields ranges from 10 to 60 percent. Rainfed, flood-prone and problem soil ecologies have the highest yield gaps, but these tend also to be the least exploitable gaps.

TABLE 1. Yield gaps for irrigated rice in selected countries

Country	Actual farm yield of irrigated rice *(tonnes/ha)*	Potential farm yield *(tonnes/ha)*	Gap *(tonnes/ha)*
India (northern zone)	4.0	6.8	2.8
Korea, Republic of	7.0	7.6	0.6
Philippines	5.5	7.5	2.0
Viet Nam	6.5	8.5	2.0
Egypt	8.5	10.4	2.1
Madagascar	4.1	6.0	2.1
Italy	6.0	9.0	3.0
Brazil (Santa Catarina)	5.5	8.5	3.0

WHAT IS A YIELD GAP?

The practical yield gap that can be addressed is the difference between the maximum attainable yield and the farm-level yield, which are defined in the following ways:

- *Maximum attainable yield:* the rice yield of experimental/on-farm plots with no physical, biological or economic constraints and with the best-known management practices for a given time and in a given ecology.
- *Farm-level yield:* the average farmer's yield in a given target area at a given time and in a given ecology.

Yield gaps can be broken down further into three components (Figure 1). The first component – Gap I – is the gap between the theoretical potential yield and the experiment station yield for which scientists conceive and breed potential varieties (such as super rice). The second component – Gap II – is the gap between the experiment station yield and the potential farm yield, and is caused mainly by factors that are generally not transferable, such as environmental conditions and some of the built-in component technologies that are

available at research stations. It is therefore difficult to narrow this component, and Gap II is often not economically exploitable.

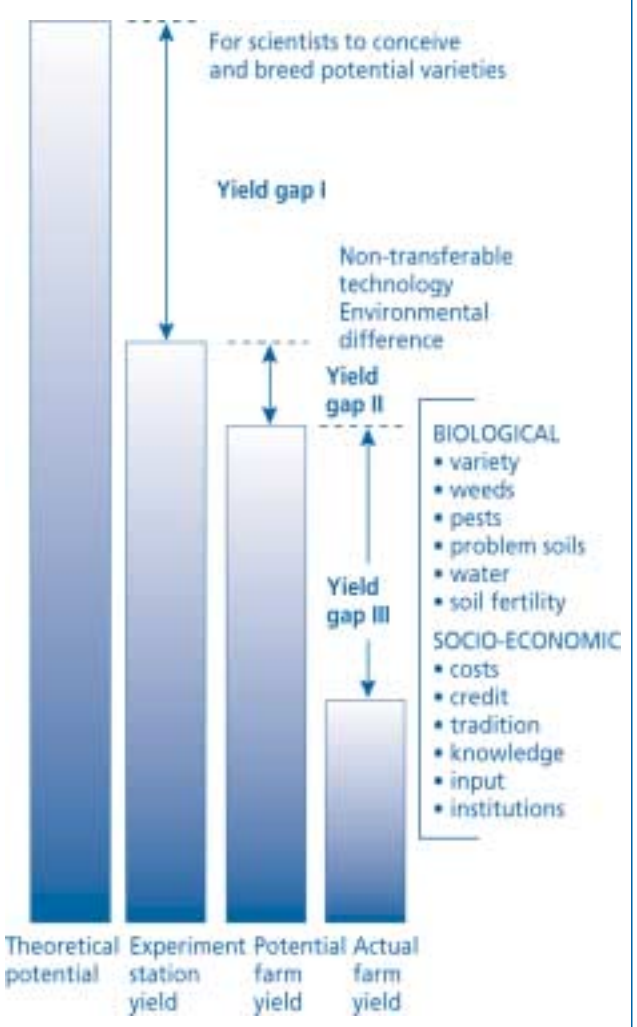
The third component of yield gaps – Gap III – is the gap between the potential farm yield and the actual farm yield, and is mainly caused by differences in management practices. Gap III exists because farmers use suboptimal doses of inputs and cultural practices. This component is manageable and can be narrowed by increasing efforts in research and extension services, as well as by appropriate government intervention, particularly in institutional issues.

THE CAUSES OF YIELD GAPS

The factors causing yield gaps can be classified according to their nature and the degree to which they contribute to the gaps:

1. *Biophysical:* climate/weather, soils, water, pest pressure, weeds.
2. *Technical/management:* tillage, variety/seed selection, water, nutrients, weeds, pests, and post-harvest management.
3. *Socio-economic:* socio-economic status, farmer's traditions and knowledge, family size, household income/expenses/investment.
4. *Institutional/policy:* government policy, rice prices, credit, input supply, land tenure, market, research, development, extension.
5. *Technology transfer and linkages:* the competence and facilities of extension staff; integration among research, development and extension; farmers' resistance to new technology; knowledge and skills; weak linkages among public, private and non-governmental extension staffs.

FIGURE 1. Yield gap components



CLOSING RICE YIELD GAPS

Narrowing yield gaps not only increases rice yield and production, but also improves the efficiency of land and labour use, reduces production costs and increases sustainability. Exploitable yield gaps in rice can be improved effectively through adopting participatory and holistic approaches to activities and actions and through government attention. An integrated programme approach is essential. The narrowing of the yield gap is not static but dynamic, and includes technological developments in rice production because gaps tend to expand when the yield potential of rice varieties is improved.

Closing yield gaps requires: i) government policy support; ii) the identification and classification of yield gaps at a particular location; iii) promotion of integrated crop management in rice cultivation; iv) deployment of new proven technologies; v) assurance of adequate input and farm credit supplies; vi) reduction of post-harvest losses; and iv) effective linkages among research, extension and farmers.

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