Economic returns to improved crops in the center of origin: The case of potato varieties in Peru

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In the last four decades, potato production in Peru increased from 1.3 to more than 3 million tons. As a result of this increase, Peru has become the major potato producer in Latina America. In this context, the International Potato Center (CIP) has achieved valuable contributions to the development of new varieties of potato in the last years.

Since 1977 CIP has collaborated in promoting in Peru 24 varieties with different characteristics in order to face diseases, improve its culinary quality or increase yield.

Two of the most successful varieties were jointly developed by CIP and the Peru's national agricultural research institution (INIA): Canchan-INIA was released in 1990 and is planted in more than 58,000 hectares today; Amarilis-INIA was released in 1993 and is planted in more than 18,000 hectares. Together, both varieties occupy more than 30% of total potato area in the country and have a major presence in domestic commercial markets. Both varieties have good culinary qualities but while Amarilis is also sought for its resistance to late-blight, Canchan's other major advantage is its earliness with respect to the variety it tends to replace, Yungay. Previous studies reported a 26% return to investment on Canchan development, but projected adoption area has more than doubled and the source of benefits for farmers has also changed. Adding the large acceptance of Amarilis by farmers has contributed to larger returns to CIP's investment on potato breeding in Peru.

Varietal characteristics and source of benefits

Canchan was released initially as a high-yielding late-blight resistant variety. It provided large net benefits in many areas of Perú going between more than $280 dollars per hectare in the long season to near $600 dollars per hectare in the short season. By the early 2000s the variety resistance begun to break down and this advantage could not be claimed any more as a source of benefit. However, the variety was already well established in the market and had a large acceptance amongst farmers because its earliness (4.5. months to mature tuberization) still allowed good market performance before production from other varieties puts downward pressure on domestic prices. The source of benefits, however, was reduced and is estimated at around $114 dollars per hectare due to lower opportunity costs of land (Maldonado et al., 2008).

For Amarilis, since its release the main source of benefits are its resistance to late-blight compared to the varieties it replaces, its earliness and good yield, although the variety is still adopted regionally in certain areas of Peru and not country-wide. Farmers' surveys have shown that the resistance to late-blight allows a reduction in fungicides costs of 24% and an increase of yields by near 9% (Salazar, pers. comm.). The estimated net benefits of the variety are set at $130 dollars per hectare, 88% of which pertain to the yield effects.

Adoption profile of Amarilis and Canchan in Peru: 1991 – 2020

In order to estimate the returns to investments in both varieties the historic adoption profile is constructed together with an estimate of the adoption ceilings for each variety until 2020. Previous studies had forecasted Canchan's ceiling at 26,000 hectares (Fonseca et al., 1996). Follow-up surveys conducted by CIP with national breeders showed that adoption of Canchan had largely surpassed this figure and the estimate of adoption for 2007 is around 58,000 hectares, making Canchan the largest single variety adopted in Peru with 22,4% of the country area (Walker et al, 2003; Thiele et al., 2008). In fact, the adoption of the variety can be verified in several potato growing regions of the country. To establish an adoption path for the next years one needs to take into consideration the actual demand for the variety and the availability of alternative varieties which will eventually

replace Canchan. Peru's national agricultural research institute (INIA) will be releasing a variety, Roja Ayacuchana, which might in the long term be a substitute for Canchan. Therefore, it seems plausible than in the long run Canchan will not be increasing in area substantially and there will be some downward pressures for its adoption. However, the new variety has still to establish a consistent market demand before Canchan can begin to decrease in area. Walker (1994) also has considered that adoption of new potato varieties take longer than other crops, a fact that seems to be confirmed by the past adoption profile of Canchan and Amarilis. We therefore establish an adoption ceiling slightly higher than the current area at 65,000 hectares and with no decrease until 2020.

Although there was not previous estimate of adoption for Amarilis, the 2007 survey put the figure in 18,000 hectares. The same considerations as for Canchan hold in this case, although the variety is on earlier stages of adoption and might continue to increase its area in the near term. We define a conservative estimate of 26,000 hectares for the adoption ceiling of Amarilis until the year 2020. Figures 1 and 2 show both adoption profiles defined with the historic information and the assumptions discussed above, and compares them with the adoption profile defined for Canchan on previous studies.

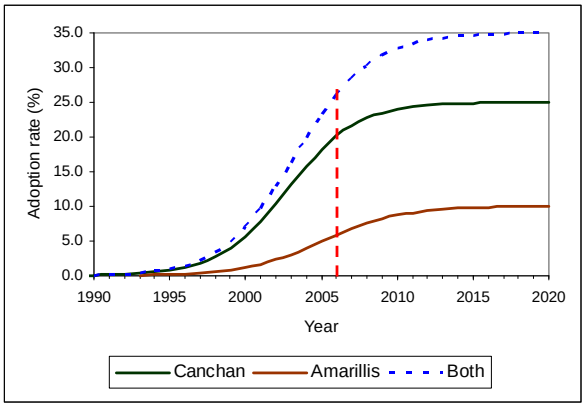

Figure 1. Estimated adoption paths for Canchan and Amarilis, 1991 – 2020

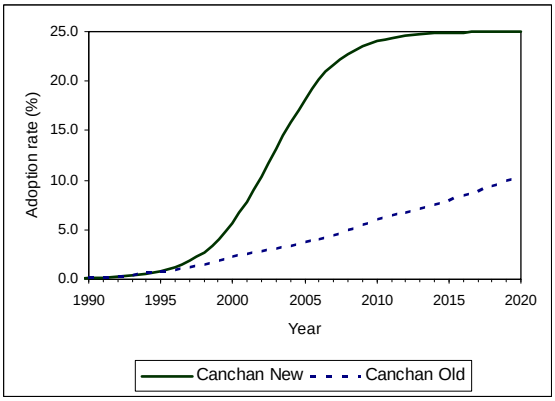

Figure 2. Old and updated adoption profiles for Canchan, 1991 – 2020

Returns to research investments

Research costs for Canchan and Amarilis are kept similar to those in Fonseca et al. (1996) for Canchan. The initial research investment for Canchan is recognized to be made in 1979, while for Amarilis the starting year for research investments is 1986. After lower initial start-up costs, the peak annual cost is near 125,000 dollars on year 12 and then decline to 60,000 dollars by year 17. Research investments are not included after year 20.

Both varieties show similar positive returns to research investments (Table 1). Given the large adoption of Canchan in Peru the internal rate of return (IRR) is near 28% and the total net present value of the net benefits generated is close to 7 million dollars. The IRR is similar to that in Fonseca et al. (1996) even though the source of benefits changed after the year 2000. Canchan's large market demand and precocity helped it to gain acceptance within farmers and the large adoption area more than doubles the area forecasted, therefore the aggregate benefits are still large despite reduced per hectare benefits.

Table 1. Canchan and Amarilis: economic returns

	Canchan	Amarilis	Both
IRR (%)	28%	27%	28%
NPV (Million USD)	6.9	4.2	8.9

The internal rate of return to research investments on Amarilis is estimated at 27%, and the net present value of the net benefits surpasses 4.2 million dollars. The returns to Amarilis are also an acceptable figure compared to international figures and similar to Canchan. In certain areas of Peru where late-blight pressure is high, Amarilis has still large potential but lack of knowledge of the variety attributes and the still reduced availibily of quality seed constraint its adoption. If the variety proves to be successful in those areas then the aggregate benefits will still increase due to larger adoption areas.

Aggregate returns to research investments in both varieties are near 28%, with an aggregate net present value of benefits of near 9 million dollars. This proves that continued investment on producing new varieties have been positive and within the expected range for returns to research investments in agriculture. Both Canchan and Amarilis are popular varieties within Peru in several regions. Canchan is very popular amongst large commercial farmers near the major cities. But it has also been adopted even in remote areas where farmers have less access to markets and where is now considered an excellent cash crop for these resource-poor farmers who also grow large number of native landraces mostly for own consumption. Amarilis, on the other hand, is seen as an excellent alternative to control late-blight in areas where the disease pressure is high and still has large potential to increase adoption as long as good quality seed becomes available.

References

Fonseca, C., Labarta, R., Mendoza, A., Landeo, J. and Walker, T.S. 1996. Impacto económico de la variedad Canchán-INIAA de alto rendimiento, resistente al tizón tardío, en el Perú. In: Walker, T. and C. Crissman. Estudios de caso del impacto económico de la tecnología relacionada con el CIP en el Perú. International Potato Center (CIP). Lima, Peru, pp. 1 – 14.

Maldonado, L., Suárez, V. and Thiele, G. 2008. Estudio de la adopción de variedades de papa en zonas pobres de Perú. International Potato Center (CIP), Lima, Peru. Working Document 2008 - 2. 37p.

Thiele, G., G. Hareau, V. Suárez, E. Chujoy, M. Bonierbale and L. Maldonado (2008). Varietal change in potatoes in developing countries and the contribution of the International Potato Center: 1972-2007. International Potato Center (CIP), Lima, Peru. Social Sciences Working Paper Series 2008-6. 46 pp.

Walker, T.S. 1994. Patterns and implications of varietal change in potatoes. Working paper 1994-3, Social Sciences Department. International Potato Center (CIP), Lima, Peru.

Walker, T.S., Bi, Y.P., Li, J.H., Gaur, P.C. and Grande, E. 2003. Potato Genetic Improvement in Developing Countries and CIP's Role in Varietal Change. In: Evenson, R.E. and D. Gollin. *Crop Variety Improvement and its Effect on Productivity: The Impact of International Agricultural Research.* Economic Growth Center, Yale University. Cambridge, MA: CABI Publishing, pp. 315 – 336.