Implications of the ban on rice cultivation in Uganda's wetlands for breeding and seed systems programing

Edgar E. Twine

Abstract

Three rice seed product market segments currently exist for Uganda: DELS-U[1] in the upland ecology and TMeLS-R and TMeLF-R[2] in the rainfed lowland ecology. In 2021, the Ugandan government prohibited the cultivation of rice and all other crops in wetlands in a bid to protect wetlands from degradation, while still envisioning rice self-sufficiency by 2030. This means that the only ecologies in Uganda where investments can be made are in the upland and irrigated lowland ecologies. We examine three questions relevant to policy and breeding efforts: (1) What is the likely effect of the ban on the country's goal of achieving rice self-sufficiency by 2030? (2) What rice yield level in the upland ecology would ensure national rice self-sufficiency by 2030 if the ban is sustained? (3) What yield level in the irrigated lowland ecology would ensure national self-sufficiency by 2030 given the ban? Under the most likely scenario for achieving the targets set in the second phase of the National Rice Development Strategy, the ban would cause a decline in the self-sufficiency ratio from the current 67 percent to 45 percent by 2030. If the ban is sustained, yield targets to ensure 100 percent self-sufficiency would have to increase from the current 1.30 tons per hectare to at least 5.55 tons per hectare on average in the upland ecology or from 3.10 tons per hectare to 12.70 tons per hectare in the irrigated lowland ecology. Implications for Uganda's breeding program are discussed in the context of seed product market segments and the targeted traits of the breeding pipelines serving the market segments.

Key points

- In July 2021, the Ugandan government announced measures to protect the environment and natural resources. Among them was the immediate ban on cultivation of rice and all other crops in seasonal and permanent wetlands.
- Under the most likely scenario for achieving targets for acreage and yield under the second phase of the National Rice Development Strategy (NRDS II), the ban will cause a decline in national rice self-sufficiency from the current 67 percent to 45 percent by 2030.
- If rice cultivation in the rainfed lowland is allowed to continue at a smaller scale (20 000 hectares instead of 60 000 hectares) to minimize negative impacts on the most vulnerable small-scale, farmers, self-sufficiency will decline to 54 percent.
- A yield level of 5.55 tons per hectare on average in the upland ecology would be enough to ensure 100 percent self-sufficiency compared with 12.70 tons per hectare in the irrigated lowland ecology.
- Investments in seed product market segments in Uganda are currently targeted toward the DELS-U segment in the upland ecology and TMeLS-R and TMeLF-R segments in the rainfed lowland ecology. However, the country's focus should be on the DELS-U segment, for which the relevant breeding pipeline is Upland Tropical.
- Investing in market segments that potentially exist in the irrigated lowland ecology would require investing in seed systems to supply hybrid varieties in a way that addresses farmers' concerns about the relatively high cost of hybrid seed and the prevalence of counterfeit seed on the market.

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This Initiative aims to maximize CGIAR and partners' returns on investment in breeding, seed systems and other Initiatives based on reliable and timely market intelligence that enables stronger demand orientation and strengthens co-ownership and co-implementation by CGIAR and partners.

[1] D = Direct seeded, E = Early maturing (90–110 days), L = Long slender, S = Soft texture, U = Upland rice
[2] T = Transplanted, Me = Medium maturing (120–130 days), F = Firm and dry, R = Rainfed lowland rice

Introduction

Rice is one of Uganda's priority and strategic commodities in the third Agriculture Sector Strategic Plan (ASSP III 2020/21–2024/25). It is important for food, nutrition and income security; import substitution; employment of women and youth; and export earnings. It is grown in three types of ecologies, namely, rainfed lowland, irrigated lowland and upland ecologies. In terms of area, rainfed lowland and upland ecologies cover 53 and 45 percent of rice ecologies, respectively, while irrigated lowlands make up only two percent (Kikuchi et al 2016). But regarding rice production, the rainfed lowland ecology contributes about 63 percent, followed by the upland ecology, which contributes 25 percent; the remaining 12 percent is from irrigated lowland.[3]

The Africa Rice Center, in collaboration with Uganda's National Agricultural Research Organization and the International Rice Research Institute has identified three rice seed product market segments for Uganda, namely, DELS-U (Direct seeded, Early maturing, Long slender, Soft texture—Upland) in the upland ecology, to be served by the Upland Tropical breeding pipeline, and TMeLS-R (Transplanted, Medium maturing, Long slender, Soft texture—Rainfed) and TMeLF-R (Transplanted, Medium maturing, Long slender, Firm and dry texture—Rainfed) in the rainfed lowland ecology, both to be served by the Rainfed Tropical breeding pipeline.

In July 2021, the government of Uganda issued 13 strict directives on conservation of the environment and natural resources, which included, among other things, an immediate ban on cultivation of rice and all other crops in wetlands (Makula 2021). This means that rice can no longer be grown in the rainfed lowland ecology, which in turn excludes the TMeLS-R and TMeLF-R segments as viable targets for investments in rice sector development in Uganda. According to the directive, households using wetlands for crop production will be encouraged to engage in alternative livelihood activities such as fish farming. This directive has direct implications for farmer demand for rice varieties; the trajectory of Uganda's rice breeding program; rice production, supply, and trade; and, ultimately, the country's ability to achieve its policy goal of attaining rice self-sufficiency as articulated in the proposed NRDS II. The self-sufficiency ratio in 2021 was estimated at 67 percent and achieving a steady increase over the next nine years is the proposed policy goal.

This brief examines three questions relating to the ban that are relevant to policy and breeding efforts. First, what is the likely effect of the ban on the country's policy goal of achieving rice self-sufficiency by 2030 as proposed in the NRDS II? Second, what rice yield level in the DELS-U segment (upland ecology), holding yield in the irrigated lowland ecology constant, would ensure national rice self-sufficiency by 2030 if the ban is sustained? And third, what yield level in the irrigated lowland ecology, holding yield in the upland ecology constant, would ensure national self-sufficiency by 2030 given the ban?[4] The national breeding program—led by the National Agricultural Research Organization (NARO)—and the National Variety Release Committee have since 2013 released 10 lowland and seven upland varieties in response to the preferences of farmers, millers-cum-traders and consumers, as documented in Lamo et al (2021). An increase in yield of 20 percent from the current 2.7 tons per hectare for rainfed lowland varieties and 3.1 tons per hectare for irrigated lowland varieties has been the breeding target for the national breeding program. Is this target still valid for irrigated lowland varieties if self-sufficiency is to be achieved without rice cultivation in the rainfed lowland? If not, what would be the appropriate targets for either upland or irrigated lowland varieties? In view of the ban and the tightening breeding budget constraint, answering these questions would be informative to the breeding program in setting priorities for its breeding efforts.

Conceptually, the immediate impact of the ban at industry level is a reduction in domestic supply of rice, leading to higher prices of rice in general and a reduction in quantity demanded by consumers. In the long run, however, because of trade and strong substitutability between domestic and imported rice (especially Tanzanian rice), there would be an increase in imports and a subsequent reduction in prices. An increase in imports means greater competition between domestic and imported rice, making the goal of achieving rice self-sufficiency an onerous task for the industry. Under these circumstances, pursuing self-sufficiency would call for, among other things, strategic breeding efforts by the national rice breeding program and perhaps appropriate seed systems programing. Breeding efforts that address the needs of different categories of farmers, millers and consumers and seed systems that are able to consistently supply high-quality affordable seed of the desired varieties would quicken the adoption and scaling of new technologies, thereby enabling domestic rice to compete favorably with imported rice.

The next section presents the methods used in this analysis and section three presents and discusses the results. Section four concludes by highlighting the implications of the ban for investments in market segments.

Methods

To determine the potential impact of the ban and the increase in yields that would be needed to achieve rice self-sufficiency, simple time series forecasting and scenario analysis were applied. Time series data on quantity of paddy produced in the country, quantity of milled rice imports and quantity of exports were obtained from the FAOSTAT database for 2005–2018 (FAO 2022). Using a milling recovery of 65 percent (Tokida et al 2014), the quantity of milled rice consumed was calculated and the trend in per capita consumption examined. The slope of the trendline was used to forecast per capita consumption of milled rice up to 2030, and total consumption and the corresponding paddy requirement (equivalent) for 2030 were calculated.

We examined the effect of the ban, while taking into consideration targets for the second National Rice Development Strategy (NRDS II: 2022–2030) for acreage and yield under upland and irrigated lowland ecologies. To

[3] Author's own calculations

[4] It is possible to increase yields in both segments simultaneously. However, we analyze yield increase in one segment at a time to keep the analysis tractable and to examine the relative importance of each segment to inform CGIAR and partners, including the government of Uganda, as to what segment to prioritize given limited resources.

calculate expected paddy production for 2030, acreage was expected to decline from 60 000 hectares to zero for rainfed lowland but increase from 50 000 to 200 000 hectares per cropping season for upland, and from 5000 to 50 000 hectares per season for irrigated lowland. Yields were expected to increase from 1.3 to 2.1 tons per hectare for upland, and from 3.1 to 3.2 tons per hectare for irrigated lowland. In calculating expected paddy production, we also considered the number of growing seasons per year in each ecology; one season for upland and two seasons for irrigated lowland. The self-sufficiency ratio for 2030 was then calculated as the ratio of expected paddy production to the paddy requirement.

Considering that targets for the first NRDS (NRDS I: 2008–2018) were never fully achieved, it is imperative to consider several scenarios. This is especially pertinent given current economic conditions, which have been characterized by two severe shocks: the COVID-19 pandemic and the recent hike in global and hence local prices of fuel and other commodities. These shocks are likely to hinder the attainment of the NRDS II targets. The COVID-19 pandemic has eroded the incomes and livelihoods of a significant proportion of Ugandan farming households (Hammond et al 2021), and the increase in food prices is likely to further impoverish low-income households in both rural and urban areas. Three plausible scenarios were considered: the first scenario assumes full attainment of the targets for both yield and acreage for the two ecologies, and the second scenario considers 50 percent attainment of acreage and yield targets for both ecologies. The third scenario looks at a 25 percent attainment of the targets.

Lastly, we determined the yield levels for both upland and irrigated lowland ecologies that would lead to self-sufficiency. Four scenarios were analyzed: holding irrigated lowland yield constant at the baseline (pre-NRDS II) level, we determined the yields for upland when acreage targets for both upland and irrigated lowland were achieved by 50 percent and 100 percent. Likewise, we hold upland yield constant and repeated the calculations for irrigated lowland. Table 1 summarizes the data on the parameters used in the analysis. The data, except that on milling recovery and rate of increase in consumption of rice, is disaggregated by rice ecology and was obtained from government reports and through expert consultations with both biological and social scientists and other rice industry experts involved in the formulation of the NRDS II.

Results

Impact of the ban on rice self-sufficiency

From the calculations, the paddy requirement for 2030 is 862 699 tons. Table 2 shows the impacts of the ban on rice self-sufficiency for the three scenarios. If the NRDS II targets are fully achieved, there will be an increase in the self-sufficiency ratio from the current 67 percent to 86

Table 1: Data on the parameters used to estimate impacts of discontinuing rice cultivation in wetlands

Parameter	Value
Milling recovery	65%
Rate of increase in per capita consumption of rice	0.55 kg/year
Upland acreage at baseline	50 000 ha
Rainfed lowland acreage at baseline	60 000 ha
Irrigated lowland acreage at baseline	5000 ha
Upland yield at baseline	1.30 t/ha
Rainfed lowland yield at baseline	2.70 t/ha
Irrigated lowland yield at baseline	3.10 t/ha
Number of cropping seasons per year in upland	1

Table 2: Impacts on rice self-sufficiency of banning rice cultivation in the rainfed lowland ecology

Scenario	Expected paddy production in 2030 (tons)	Self-sufficiency in 2030 (%)
Scenario 1: Full attainment of NRDS II targets - Upland acreage: 200 000 ha - Irrigated lowland acreage: 50 000 ha - Upland yield: 2.1 t/ha - Irrigated lowland yield: 3.2 t/ha	740 000	86
Scenario 2: 50% attainment of NRDS II targets - Upland acreage: 125 000 ha - Irrigated lowland acreage: 27 500 ha - Upland yield: 1.7 t/ha - Irrigated lowland yield: 3.15 t/ha	385 750	45
Scenario 3:25% attainment of NRDS II targets - Upland acreage: 87 500 ha - Irrigated lowland acreage: 16 250 ha - Upland yield: 1.5 t/ha - Irrigated lowland yield: 3.125 t/ha	232 813	27

percent. However, should the targets be achieved by only 50 percent, self-sufficiency will decline to 45 percent, and 25 percent attainment of the targets implies 27 percent self-sufficiency. It is difficult to predict how long the economic impacts of the COVID-19 pandemic and impacts of the hike in commodity prices will last, but based on experience from the first NRDS, scenario 2 is the most plausible of the three scenarios. This will inevitably lead to a substantially large rice import bill, making the ban counterproductive to the government's efforts toward import substitution.

The results of scenarios 2 and 3 lend support to the idea proposed in the NRDS II that rice cultivation in rainfed lowlands should not be totally discontinued. Rather, acreage should be reduced from the current 60 000 hectares to at least 20 000 hectares in 2030 to protect the livelihoods of the most vulnerable smallholder farmers, while maintaining yield at 2.7 tons per hectare to avoid intensification that might adversely affect the environment. Factoring this into scenario 2 and considering 1.5 cropping seasons for the rainfed lowland ecology, we obtained a reasonable self-sufficiency ratio of 54 percent.

Yield levels needed for self-sufficiency

Table 3 shows the yield levels needed to achieve 100 percent self-sufficiency in 2030 under four scenarios when there is a complete ban on rice cultivation in the rainfed lowland ecology. Since the NRDS II targets for acreage are likely to be achieved by only 50 percent, breeding (and extension) efforts might as well focus on obtaining a yield level of at least 5.55 tons per hectare on average in the upland ecology. In any case, 5.55 tons per hectare in the upland ecology is more conceivable than 12.70 tons per hectare in the irrigated lowland ecology in the Ugandan context. Some of the upland varieties released since 2013 such as NamChe 5 can produce more than 5.55 tons per hectare (Lamo et al 2017).

Based on these results, it would be prudent for the breeding program to target market segments in the upland ecology. Nevertheless, it would inevitably have to respond to the expected ban-induced increase in demand for upland rice varieties, some of which have been observed to be relatively high yielding (4–6 tons of paddy per hectare), early maturing, drought resistant and consequently profitable (Kankwatsa et al 2019). A case in point is MET 12 (also known as NARORICE-2 or TOCI), released in 2021. It is high yielding, with a yield potential of 6 tons per hectare (NaCRRI, 2021), and aromatic and is already popular with farmers.

Summary and implications for investments in rice segments

The study analyzes the impacts of discontinuing rice cultivation in Uganda's rainfed lowland ecology using time series forecasting and scenario analysis. Results indicate that the ban would significantly lower the country's self-sufficiency ratio from the current 67percent to 45 percent by 2030. However, if some rice cultivation, at least 20 000 hectares, is allowed to continue in this ecology as proposed in the NRDS II, self-sufficiency would likely stand at 54 percent in 2030. If the breeding program is to focus on improving yields solely in the upland ecology, it would have to aim for about 5.55 tons per hectare to achieve 100 percent self-sufficiency. But if it is to target the irrigated lowland, it would have to aim for 12.70 tons per hectare. Achieving this average yield level even with hybrid varieties is implausible. For instance, two recently released hybrid varieties suitable for irrigated lowland, ARIZE-1 and CHIGA-1, have yields of 7.9 tons per hectare and 9.6 tons per hectare, respectively (Lamo et al 2021). Besides, farmers have expressed some concerns about the cultivation of hybrids, specifically their generally low level of profitability due to the exorbitant cost of seed, and the prevalence of fake hybrid seed on the market (Rice Association of Uganda 2020).

Table 3: Yields needed to attain 100 percent self-sufficiency under different scenarios

Constant irrigated lowland yield (3.10 t/ha); baseline upland yield (1.30 t/ha)	
Scenario	**Upland yield (t/ha)**
Scenario 1: Full attainment of NRDS II acreage targets - Upland acreage: 200 000 ha - Irrigated lowland acreage: 50 000 ha	2.75
Scenario 2: 50% attainment of NRDS II acreage targets - Upland acreage: 125 000 ha - Irrigated lowland acreage: 27 500 ha	5.55
Constant upland yield (1.3 t/ha); baseline irrigated lowland yield (3.1 t/ha)	
	Irrigated lowland yield (t/ha)
Scenario 3: Full attainment of NRDS II acreage targets - Upland acreage: 200 000 ha - Irrigated lowland acreage: 50,000 ha	6.00
Scenario 4: 50% attainment of NRDS II acreage targets - Upland acreage: 125 000 ha - Irrigated lowland acreage: 27 500 ha	12.70

The findings have two important implications for investments in rice seed product market segments in Uganda. First, priority for investments in breeding should be given to the DELS-U segment for which the relevant breeding pipeline is Upland Tropical. Second, besides grower traits such as yield potential, drought tolerance and pest and disease resistance, it will be imperative to critically focus on consumer-preferred traits because the likely influx of imported rice will make it harder for domestic rice to compete favorably. For instance, in setting breeding targets, the current reference variety remains NERICA 4, which is non-aromatic. Yet Ugandan consumers are known to prefer aromatic to non-aromatic rice (Masette et al 2013). Therefore, the appropriate reference variety henceforth might as well be a high yielding aromatic upland variety such as MET 12. Other than aroma, price is an important consideration for Ugandan consumers and that is why market segments for the relatively cheap non-aromatic varieties such as Kaiso and NERICA 4 remain significant (Britwum et al 2020). Thus, development and dissemination of varieties that are affordable to consumers should be of interest to breeding and seed systems programs.

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Author

Edgar E. Twine is an associate principal scientist at the Africa Rice Center. He holds a PhD in Agricultural and Resource Economics from the University of Alberta (2014). His research focuses on agricultural marketing, production and policy analysis.

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