



 **Short
Communication**

Volume 1 No: 5 (2017)

Innovation Opportunities in Irish Potato Value Chain in Mali

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October 2017



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Center for Development Research
University of Bonn
ZEF Bonn

ISSN 2550-3359



9 772 550 33 5000

Citation

Kergna AO and Dembélé D (2017). Innovation Opportunities in Irish Potato Value Chain in Mali. FARA research Results Vol 1(5) PP14

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ISSN: 2550-3359

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Acknowledgements

This work was carried out within the Program of Accompanying Research for Agricultural Innovation (PARI), the PARI project is coordinated at the global level by the Center for Development Studies (ZEF), University of Bonn in Germany. The PARI project is also coordinated in Africa by the Forum for Agricultural Research in Africa (FARA). The funding for this work is provided by the German Federal Ministry of Economic Cooperation and Development (BMZ). The authors wish to acknowledge the contributions of the different individuals in ZEF and FARA for the reviews of the proposals and the final outputs of the research endeavours. The contributions of Dr. Fatunbi Oluwole and its team in FARA, as well as Dr. Heike Baumüller and her team at ZEF are well acknowledged.

The authors further wish to acknowledge the contributions of all the potatoes value chain actors in the Sikasso and Kati Districts, which enabled us to gather quality data for this report. We are also indebted to the Sikasso District Director for Agriculture as well as the Kati and Sikasso Districts Extension Officers who played a key role in organizing the potatoes value chain actors and facilitating the formation and inauguration of the potatoes Innovation Platforms in both Districts.

We would also like to thank all the facilitators of the participatory workshops that were also used to gather data for this report. They are Abdoulaye Bamba (President of potatoes producers' association), Fodé Konaté and Hamady Ndjim who are both experts in the project PCDA. We also acknowledge the contributions of all the participants at these workshops as that enabled us to get much insight into the constraints and interventions for the potatoes value chain. They include potatoes farmers and traders in the two project districts as well as Researchers in IER.

We are also indebted to Modibo Samaké and Mamadou Camara, PCDA Personnel who played various roles including facilitating data collection, data entry and analysis.

Abstract

Due to increasing urbanization, potatoes have become an important food crop in most Malian cities. Despite long-term investment in the potato value chain, achieving major gains in returns is still a major challenge. This paper briefly assessed the potential economic benefit for the different actors in the potato value chain using participatory appraisal in two regions of Mali (Sikasso and Koulikoro). We used “structure, Conduct and Performance” approach to assess the whole value chain of the crop. Farmers and their organizations, state and para-state institutions were surveyed to capture the constraints and opportunities along the value chain. Our findings indicated that there are high potentials for potato production in the country; prices are volatile during the year and the product could be exported to neighboring countries at a competitive price. However, many infrastructures are needed for conservation, packaging and transportation. The cost of some services remains still very high (electricity) and it constitutes a major challenge for conservation and stabilization of price in the market.

Key Words:

Potatoes, Value Chain Development, Value Chain Analysis, Mali, Intervention strategies

Background

The Republic of Mali, a vast landlocked Sahelian country in West Africa, is subject to strong climatic and other natural constraints. A high population growth exerts pressure on the country's resources. The population, young and predominantly rural, is largely engaged in the agricultural sector, which is the mainstay of the economy. Poverty affects more than half of the population.

Irish potatoes, *Solanum tuberosum*, are grown for their tubers. The crop has been cultivated in Mali for decades, during the cold dry season. The vegetative cycle varies depending on varieties but the average cycle ranges between 90 and 110 days. The main production zones in Mali are the districts of Sikasso and Kati. The crop has recently been introduced in the Office du Niger zone. Eighty percent of the potatoes produced in Mali is from Sikasso.

Irish potatoes perform well in light, slightly humid soils rich in well-decomposed organic matter. Heavy soils reduce the germination rate and size of tubers, and make harvesting difficult. Humid and poorly drained soils lead to various diseases. Irish potatoes germinate well in places with cold dry seasons and long, cool nights. Soils with high temperatures cause seeds to rot and reduce the germination rate. Water requirements of Irish potatoes range between 50 and 80 m³/ha/day.

Potato plants are subject to attack by worms, insects, acarians, and fungi, which often cause significant damage to leaves, stalks, and even tubers. Careful choice of land, proper land preparation, and use of healthy seeds could considerably reduce risks of attack.

Crop rotation is necessary; however, in Sikasso, parasites are apparently eliminated through submersion of inland-valley soils, which occurs for 2 months in a year. The main constraint to potato production is lack of water.

Production operations and processes

Most of the seed is imported from Europe. A minimum of 40 cages of 25 kg of seed each are needed per hectare, which translates to 1-2.5 tons of seed per hectare. Table 1 shows the various operations and processes used in potato production, with the necessary time frame.

Production constraints and identified hindrance to productivity and profitability

Several Irish potato varieties are grown in Mali, the major ones being Pamina, Claustar, Aïda, Spunta, and Sahel. The "lab d'agro-physio-génétique et de biotechnologie végétale" of IPR de Katibougou, initiated a programme in 1998 on *in vitro* potato seed production in collaboration with IER and on the demand of producers and partners. The aim was to produce micro tubers for supplying producers directly with quality seeds. However, the laboratory is underutilised

Table 1: Operations and processes used in potato production, with associated time frame

Operation	How and when operation is effected
Pre-germination treatment	Protect seeds from the sun for 2-3 weeks before planting
Land preparation	Prepare land in October-November. Land preparation involves three steps: (i) cleaning a new field or using an old field with long-duration rotation; (ii) deep plowing to 30-40 cm; and (iii) seedbed preparation: hole, ridge or flat
Planting	Plant tubers at a depth of 5—10 cm in November--December. Planting density varies with variety.
Watering	Water moderately to avoid rotting; water regularly during plant development; reduce watering frequency at maturity, and stop 2 weeks before harvesting.
Protection	Usually potato fields are not sprayed in Mali. They are however protected against animals. Appropriate cropping practices are used to prevent or reduce attack by pests.
Fertilisation	If compost manure is available, use it instead of mineral fertiliser.
	The quantity of organic matter should range between 10-15 chart loads equivalent to 10 tons per hectare.
	Application of mineral fertiliser varies with variety and production objectives. For conservation, fertiliser dosage varies between 500 and 1000 kg/ha. For immediate sale, the dosage varies between 1000 and 2000 kg/ha.
Harvest	Harvest in February-March.
Conditioning/processing	Sort tubers in the field and condition them in netted bags.
Conservation	In local conditions tubers may be conserved for 1-3 months in a cold, windy, dark room.
	Post-harvest losses could reach 30--50 percent under poor conservation conditions.
Seeds are protected from the sun for 2-3 weeks before planting.	

due to lack of qualified staff and a cold chamber for conserving seeds. Another problem that hinders seed production is a shortage of multiplication sites.

Quantities produced were estimated to reach 100 000 tons in 2016, assuming that 34 000 ha were cultivated. There are no actual data on total production, but estimates show that it increased from 35 000 tons in the 1990s to 50 000 tons in 2006. Most of the potatoes produced in Mali are sold on internal markets and the remaining are exported to Cote d'Ivoire, Burkina Faso, Ghana, Togo, and Senegal.

Average yield is estimated to be 20 to 25 tons/ha. The potato industry employs producers and hires workers throughout the year and hence reduces movement of youth to urban areas. During the rainy season, only small quantities are produced (harvested in August) due to conservation problems. Table 2 gives the labour requirements for cultivating one hectare of potatoes in a year.

Table 2: Labour requirements for cultivation one hectare of potatoes in a year

Activity	Number of man days
Land preparation	88
Planting	26
Watering	183
Ridging	61
Harvesting	21
Sorting	13
Total	392

In Mali, potato yield can decrease to 12 tons/ha due to poor access to fertiliser and good seeds. In the Office du Niger area where irrigation water is available throughout the year, potatoes rot and fail to develop tubers because the soil is heavy. Potato production in this zone is new, so farmers still lack experience. They use small quantities of organic manure; irrigation limits development of diseases.

Since the potato is not a strategic crop for food security in Mali, it receives little support from the government to increase productivity and production. Moreover, potato production requires significant labour, which is not available in many households.

Watering and land preparation are the most labour-demanding activities. Many households do not have irrigation equipment due to poverty and limited access to credit. In Sikasso District where most of the potatoes are produced, land is not developed for gravity irrigation; only a few farmers have the capacity to buy the necessary equipment and irrigate their fields.

Maintenance and fuel costs engendered by water pumps are not affordable by many producers. Individual farmers have to fence their farms, which is also costly. The picture below shows a man irrigating his fenced potato farm.

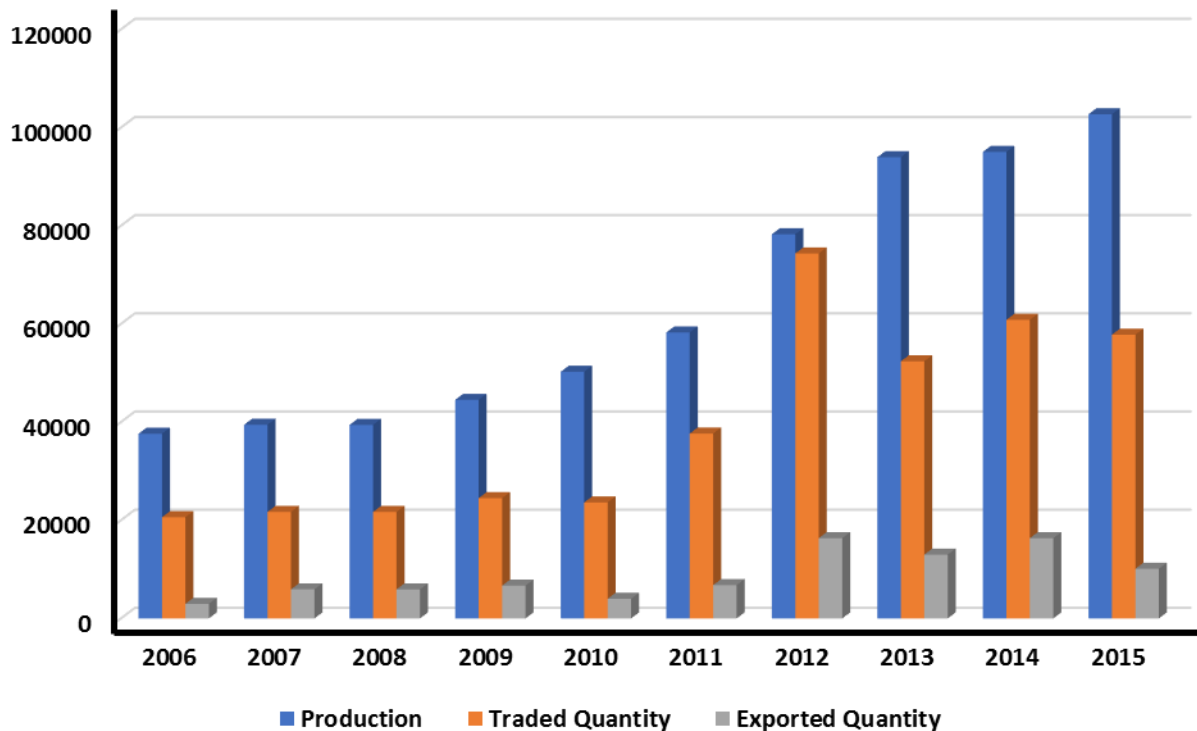


Figure 1: Irrigating a fenced potato farm

Production of potatoes in Mali

Total production has increased during the last ten years from 37 632 tons in 2006 to 102 718 tons in 2015. This increase could be explained by more availability of good quality inputs (seed and fertiliser) and efforts by extension workers to increase acreage under the crop. For example, potato production is increasing in the Office du Niger zone, where rice is the main crop.

Mali exported 2,978 tons of potatoes in 2006 and 10109 in 2015. The following graph shows the evolution of potato production, quantities traded, and those exported in Mali.



Source: Country Statistics

Figure 2: Evolution of potato production, quantities traded, and those exported in Mali (tons)

Production constraints

The main constraints in potato production in Mali are:

- **Access to proper seed.** Very few entities are engaged in importation of seed from Europe. During the rainy season, farmers use the small quantities of tubers from their own crops as seed. Micro-tubers are being developed by IPR de Katibougou, but the process is hampered by shortages of human resources and funding. In Sikasso, seed importers have built relationships with farmers and provide them with seeds and fertiliser on credit basis. Therefore, seed and fertiliser costs are fixed by the importers and not the market. Imported seeds are very expensive, are supplied late, and are often of bad quality because they are conserved under poor conditions. Replacement of fertiliser by organic manure is hampered by limited availability of manure. The quantity required per hectare is estimated at 25 tons, which farmers can hardly find.

- **Access to labour.** Watering requires much labour, yet the number of persons per household is low. Poverty compels many youths to move to urban areas temporarily in search of livelihoods. Most households do not have sufficient resources to hire labour. Whereas manual watering could be replaced with pumps, these too are often prohibitively costly for most farmers.
- **Access to credit.** Credit is provided only for cotton production; other crops do not receive any support from the government or extension services for accessing credit to purchase fertilizer or seeds.
- **Storage and conservation.** The crop is sold immediately after harvest to minimize depreciation due to inadequacy of conservation facilities. Quantities lost could reach about 30-50 percent.

Identified hindrances to productivity and profitability

A laboratory already exists at IPR de Katibougou, but it needs staff and equipment. Investing in the laboratory would increase potato seed production in Mali and reduce importation from Europe; it would also reduce costs of seeds. Mali has large areas of land that are suitable for production of potato seeds. Reduction in the cost of seeds would considerably increase profitability of the potato enterprise.

Several agricultural schools exist across the country; these could train many technicians in potato production. The trained technicians could in turn train farmers. The increased number of trained farmers would translate into increased production. In fact, it would be possible to grow potatoes in all regions in Mali.

Input suppliers in Sikasso would provide farmers with good quality seed and fertiliser.

It is possible to grow potatoes during the rainy season using varieties with short dormancy.

Innovation Opportunities

Researchers have developed technologies in several aspects of potato production.

Technical aspect. It is important for farmers to have sufficient quantities of good quality seed. Unfortunately, farmers usually buy small quantities of seed to save money. The recommended seeding rate is 1000 kg/ha, but farmers seed their farms with as little as 750 kg/ha; they still get yield averages of 25 tons/ha.

Farmers would stop using mineral fertiliser if they had access to sufficient quantities of good quality compost manure. Since it is difficult for farmers to apply the required quantities of organic manure, they could supplement it with small amounts of mineral fertiliser to reduce production costs. The fertiliser could be applied at 200 kg/ha.

The recommended planting density is 60 cm between rows and 40 cm between plants. However, farmers do not follow this recommendation.

Farmers continue watering their crops even when plants are at maturity, yet watering should stop 2 weeks before harvesting. Avoid cutting tubers while harvesting. Water moderately to minimise diseases, and avoid wetting the leaves.

If farmers want to store their harvested produce, they should avoid using urea during the vegetative stage. To control insects, farmers should uproot and burn affected plants rather than apply insecticides. Since most farmers cannot afford cold chambers, they should store their produce using solar energy or aerated rooms.

Institutional organisation. A potato producers' network should be established at the national level to improve trading in ECOWAS. Such a network would also enforce common legislation in potato seed production, seed multiplication, and certification. This would enable potato farmers to access good quality seeds at affordable costs and thus develop their farms.

Infrastructural set up. One of the main problems in potato production is potato conservation. Cold chambers are not affordable to farmers because of the high cost of energy. Most of the potato-producing villages do not have access to electricity and blackouts are frequent where electricity is available. Farmers use aerated rooms with low storage capacities and high rates of loss during storage. Solar-powered rooms could be used to conserve potatoes for longer periods with reduced losses. Actually, solartechnologies for providing cooling systems (SOLAREF) exist.

As already mentioned, there is a laboratory at IPR de Katibougou for producing low cost potato seeds, but it lacks staff and facilities for seed multiplication. This laboratory could be networked with other facilities in countries within the Sahel or in Europe for complementation.

Market. Potatoes are sold in bulk in rural markets; varieties are mixed, and volumes are not sorted. Sellers are poorly organised individual producers who receive payment in cash. Prices are unstable and could vary from 150 to 600 CFA/kg. Volumes traded are low; due to poor organisation, farmers cannot avail potatoes on the market all year round. The market is poorly structured, which limits activities of many actors. It has a short distribution channel from February to June and a long distribution channel that lasts the entire year. During the short distribution channel, about 15 percent of the produce is availed at various consumption centres; 85 percent of the produce is sold to whole exporters, and retailers on the Sikasso market.

Policies. The emerging producers' association does not have the means to regulate supply and prices. With the lack of storage infrastructure, the Sikasso market is only a transit place. Collected potato volumes are immediately directed to consumption centres and other countries. Production techniques are still traditional and poorly adapted to the quality requirements of local and international markets. Credit policies are based on cotton in the main producing zone (Sikasso), and many farmers are still indebted.

Value chain analysis

Input Suppliers

CikelaJigi (covers about 30 percent of the needs in seed), Mali Yiriden and La Sikassoise are the main input suppliers for potato production. The seed is mostly imported from Europe. Seed suppliers are concentrated in the Sikasso region. They benefit from funding through banks for importing seeds. The banks also supply farmers with fertiliser and develop with them a collaboration based on mutual trust. The cash flow of potato seed and fertiliser is estimated at 45 billion CFA per year. There is no specific distribution system for potato fertiliser. Potato seed is sold at 1000 CFA/kg; fertiliser is purchased at a cost ranging from 18000 to 25000 CFA/bag on the market and 11000 CFA/bag if subsidised. Organic manure is estimated to cost 12 CFA/kg.

Producers

There are independent producers who don't belong to any organisation, and there are producers' organisations. Improving potato production and productivity. The credit system is not appropriate because it is directed towards cotton alone, preventing other crops such as potatoes from accessing it.

Trading

Traders are structured in distinct categories, which are specified below;

Whole sellers: they are from Mali and neighbouring countries (Burkina Faso, Ivory Coast, Ghana, Togo). Eighty percent of the product is marketed in Sikasso. They deal directly with individual producers who are poorly organised. Transactions are in cash and the potatoes collected are sold in consumption centres within and outside the country.

Retailers: Sale prices vary between 100 and 300 CFA/kg and could reach 600 CFA/kg for urban consumers; price is related to quality. Three major quality products are registered: big size; medium size and small size. Table shows inputs and yields with corresponding costs in a potato enterprise.

Despite the importance of potatoes in the local economy of Sikasso, its production had never received any sound direct support from the government and other stakeholders. However, the World Bank and USAID support some projects. Projects such as Trade Mali, Mali Finance, PRODEPAM, and PCDA provided support for promoting trade, accessing credit, and

Table 3: Inputs and yields with corresponding costs in a potato enterprise

Item	Unit	Quantity	Unit price	Amount (CFA/ha)
Seed	cage	40	25000	1 000 000
Fertilisation				
-mineral	bag	20	20000	400 000
-organic	kg	5000	12	60 000
Man power	M/d	392	1000	392 000
Gas	litrer	488	675	329 400
	bag	800	250	200 000
Transport	kg	25000	10	250 000
				60 000
Total charges				2 691 400
Product	kg	25000	200	5 000 000
Cash flow				
Net Margin				2 309 000
Production cost	CFA/kg			108



Figure 3: Potatoes of various sizes and quality attributes for sale

Summary and Conclusion

Several incentives show that the potato value chain has good prospects in Mali. Mali people are increasingly consuming the potato and internal demand is increasing. Possibilities exist to extend potato production in Mali. The country has many potential production zones and new partnerships are being developed to increase potato production. Researchers are working to increase potato production and are focusing on the use of potato varieties that are resistant and tolerant to diseases caused by bacterial wilt (*Ralstoniasolanacearum*) and scab thread worm (*Meloidogyne* sp.). Local infrastructure for supplying seeds is being established in the country. The value chain is becoming organised. To ensure high yields of good quality potatoes, there should be common legislation among ECOWAS countries regarding seed production, multiplication, and certification. In addition, the conservation problem should be addressed to avoid limiting the potato value chain.

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