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Making smallholder agricultural production work: What we can learn from the socioeconomic and agrarian transformation through agro-well access in the North Central Province of Sri Lanka

The North Central Province (NCP) is situated in the Dry Zone of Sri Lanka. Average annual rainfall in the province is less than 1,750 mm, of which very little occurs between May and September (dry season). An estimated 12,000-16,000 irrigation tanks, mainly situated in villages, have been constructed since 300 BC to store surface runoff to support dry-season rice cultivation, which is practiced in addition to rain-fed rice production. However, dry-season cultivation remained at subsistence levels, with slash-and-burn agriculture in the highlands complementing limited lowland paddy production. Therefore, poverty levels in rural areas continued to persist, due to rural economies being largely dependent on subsistence agriculture. This scenario has changed with the recent use of groundwater to intensify dry-season cultivation in some parts of the Dry Zone. In the late 1980s, under the government's National Agro-well Program, subsidies were provided to farmers in NCP for the construction of shallow (~6-8 m), large diameter (~8 m) open wells and for the purchase of diesel pumps. The program primarily focused on poverty alleviation and food security. Early signs of success of the program attracted further support from NGOs and provincial ministries, although investments by farmers themselves soon became a major driver in the expansion of agro-wells (Karunaratne and Pathmarajah 2003).

A farmer in the Anuradhapura district irrigates his onion crop using water from an agro-well *(photo: Sanjiv de Silva/IWMI)*

This new groundwater-driven production system has transformed forested land into high-value crop production systems, which have contributed significantly to improving household food self-sufficiency, incomes and climate resilience. In addition to documenting the increased diversification, productivity, resilience and profitability of this groundwater-driven cultivation system, this case study highlights that concurrent off-farm investments in land tenure, markets, communications, transport, trade policies, finance and inputs at subnational/national levels are vital conditions to achieve pro-poor outcomes.

KEY MESSAGES

- In agrarian economies, the cultivation of low-profit staple crops could meet subsistence needs, but poverty levels may still persist. Striking a balance between staple crops and high-value crops using climate-smart agricultural practices, including groundwater use, could help drive food security and poverty reduction.
- Access to and control over groundwater supports climate resilience, and offers farmers a competitive advantage compared to those without access to this resource.
- The ultimate success (food security, profitability) of cultivation systems depends on a range of enabling technological, structural and financial investments (land tenure, markets, communications, transport, trade policies, finance and inputs) at plot to national scales. Some of these investments are made by farmers and governments, and others by the private sector and nongovernmental organizations (NGOs).

METHODS AND APPROACH

This research study focused on four villages in the Anuradhapura district, where a high density of agro-wells support intensified agricultural production systems. During the period from November 2013 to October 2014, quantitative primary data were collected through a structured household questionnaire, while qualitative data were collected through semi-structured interviews conducted with government officials, female and male farmers, village elders and private sector actors. Primary data collection was supported with field observations, local government data and a review of existing literature. The collected data covered the evolution of agro-well-based cultivation and associated crops and cropping patterns; agricultural income and production costs; irrigation practices; village-level poverty and employment; evolution of policy and regulatory environments; political economy of land use regulations in relation to the conversion of the state's forestland to private farmland; and the emergence of value chains driven by both the state and the private sector.

RESULTS AND CONCLUSIONS

Agro-wells have generated transformative change in agricultural production and socioeconomic status

Using this on-demand source of irrigation water, subsistence dry-season crops have been replaced with high-value crops such as chili and onion. While average net annual income from 1 acre (0.404686 hectares) of paddy is approximately USD 994, the equivalent income from onions and chili can be as much as USD 5,561 and USD 4,231, respectively. This multi-fold increase in income has financed major improvements in the well-being of households, such as improved food security, quality of housing, transport (motorbikes) and agricultural mechanization. Survey respondents attributed this to the income gained from agro-well-based agricultural production, a claim supported by official village employment statistics which indicate that only 16% of those between 18 and 60 years of age are employed outside the agriculture sector. In the highlands, the crop cultivated in the wet season also changed from soya to maize, while onions and chilli were the dominant crops in the dry season. The number of agro-wells increased from 64% to 179% in the study villages from 2002 to 2012. Land under highland cultivation also expanded from an estimated average of 1 acre per household in 1985 to 5 acres today, which may have been at the cost of converting much of the surrounding forests, and causing conflict between people and wildlife such as elephants, who pose a threat to crops, physical property and human lives.

The resilience of this agro-well-based agricultural production to climatic stress was demonstrated during the prolonged drought marked by several months of below-average rainfall between September 2013 and December 2014. While this reduced agricultural production by approximately 40% at national level[1], farmers in the study villages increased net incomes from chili and onions when these crops were abandoned in parts of the Dry Zone where there are no agro-wells. This led to a shortage in the supply of these products and hence large price increases.

What else made this success possible? Looking beyond agro-wells and pumps

The success of this agricultural production system in generating pro-poor outcomes cannot be explained by agro-wells and pumps alone. Tracing its evolution reveals diverse contextual enabling factors at play, covering social, political, institutional, economic, ecological and physical dimensions as shown in Figure 1. Many of these elements, moreover, have a concurrent evolutionary trajectory to the agricultural production system itself that reflects broader developmental processes.

The government's National Agro-well Program provided the original impetus. Political patronage, expressed as outright gifts of agricultural technology or subsidies during local and national elections, also helped. Private sector credit facilities with service delivery to nearby towns and villages further enhanced access to finance. This facilitated expansion of agricultural mechanization from pumps to tractors, combined harvesters, threshers, dryers and vehicles to transport produce to markets. Mechanization also controlled labor costs and reduced the time needed for land preparation and harvesting.

A typical agro-well in the Anuradhapura district
(photo: Sanjiv de Silva/IWMI)

[1]Sri Lanka: Drought - August 2014 (http://reliefweb.int/disaster/dr-2014-000120-lka).

FIGURE 1: DRIVERS AND OUTCOMES ASSOCIATED WITH AGRO-WELL-BASED AGRICULTURAL PRODUCTION.

DRIVERS	
Agro-wells	▪ Dry season water security ▪ Flexibility in irrigation ▪ Unusually high density but wisely managed
Government support	▪ Periodic programs (central, provincial, etc.) ▪ Aid distributed during political campaigns
Capacities	▪ Knowledge of crops ▪ Capacity for self-regulation ▪ Knowledge of external institutions (buyer, markets, credit sources)
Social relations	▪ Kinship and friendship networks ▪ Flexibility ▪ Gender mobility
Land	▪ Availability of forests to convert ▪ Sympathetic law enforcement
Credit	▪ Diversification ▪ Mutual confidence
Markets	▪ Dambulla market ▪ Forward contracts ▪ Favorable national demand-supply conditions for key crops (supply deficits)
Mechanization	▪ Pumps, tractors, harvesters, dryers, vehicles for transport, motorbikes
Infrastructure	▪ Roads ▪ Mobile phones ▪ Dambulla market

Highland production with feedback loops between Drivers and Outcomes

OUTCOMES	
At household scale	
Control over more productive assets	▪ Increased cropping area due to forest conversion and regularization ▪ A secondary source of irrigation (groundwater) where individual farmers can take independent groundwater use and management decisions
Resilience	▪ Ability to withstand drought conditions
Transformation in income levels	▪ Increased annual income between USD 4,231 and USD 5,561 from a single acre of highland cultivation ▪ Continuous income throughout the year
Increased physical assets	▪ Improved housing ▪ Motorcycles for transport ▪ Household appliances such as televisions
At community scale	
A renewed interest in agriculture	▪ Almost full engagement of households, including youth, in agriculture
Potential aquifer drawdown	▪ A risk if agro-well expansion continues or cropping intensity increases
Potential aquifer pollution	▪ Past studies suggest this to be a likely externality ▪ Risk to human health, and soil quality and productivity
Potential impacts of land use changes	▪ Loss in water-holding capacity of village tanks due to siltation ▪ Loss of forest habitat causing loss of biodiversity and an added risk to human safety and crop production due to human-wildlife conflict
At national scale	
Increased food production	▪ Production of other field crops contribute to reducing domestic supply deficits, especially in the dry season
Contribute to easing balance of payments pressures	▪ An increase in domestic production will reduce the need for imports

The lax enforcement of forest regulations by the Forest Department and local government enabled land conversion. Interviews conducted with officers from these institutions confirmed that poverty alleviation was consciously prioritized over rule enforcement. This was also driven by strong kinship and other social relationships, since many local government and line agency staff were local recruits with close ties to these farming communities. Social networks also helped to maintain low labor costs through traditional reciprocal forms of free labor among households.

The concurrent development of agricultural markets has been critical in absorbing production at prices that have thus far outstripped costs of production and farmers' perceptions of risk. The government invested in a wholesale fruit and vegetable market in Dambulla as part of a network of regional collection centers linked to markets across the country.

The price of highland rain-fed maize – a key ingredient in local breakfast cereals – doubled after several private companies began offering forward contracts for the produce. Their sourcing network replaced a more exploitative market controlled by local middlemen. Improvements in the rural road network and mobile communications enabled negotiations between farmers and buyers, and linked farmers to diverse markets, credit providers and state sector service providers.

Market structure is also central to the profitability of chili and onions. Since domestic production only accounts for approximately 50% of national demand, sharp short-term price spikes (especially for chili) during the dry season enable farmers to achieve significant profit margins. This is also possible because chili can be continuously harvested once the plant reaches maturity, whereas the harvesting of paddy or most other field crops occurs only at the end of the season. Another factor is the aim of the government fiscal policy to reduce the financial burden of high food imports (Sri Lanka Government Ministry of Agricultural Development and Agrarian Services 2008). Therefore, this prompts an increase in tariffs on imported onions at the time of local harvests to ensure farmers achieve sufficient profit margins, and to encourage further investment in production.

This case study demonstrates that establishing and sustaining new crop production systems must be conceptualized as part of broader national/subnational development strategies, which lead to multi-sectoral (on- and off- farm) investments to achieve optimal production and sufficient income while managing risks.

However, the study also highlights the need to monitor both water quality and abstraction rates due to the significant loss of forest cover and cropping intensity, which raises water demand and increases the use of agrochemicals. If not managed, abstraction beyond sustainable levels and water pollution can put the future of these highly lucrative production systems at risk.

REFERENCES

Karunaratne, A.D.M.; Pathmarajah, S. 2003. Groundwater development through introduction of agro-wells and micro-irrigation in Sri Lanka. In: *Use of groundwater for agriculture in Sri Lanka: Proceedings of a symposium*, (ed.) Pathmarajah, S. Peradeniya, Sri Lanka: Agricultural Engineering Society of Sri Lanka (AESSL), Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya. pp. 29-41.

Sri Lanka Government Ministry of Agricultural Development and Agrarian Services. 2008. *"Let us cultivate and uplift the nation."* National campaign to motivate domestic food production 2008-2010. Proposed plan for Presidential Task Force.

SOURCE

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