Strengthening Quality Seed Potato Production in Sri Lanka through Viable Public-Private Partnerships (PPP)

Kuruppu I. V.[1*], Amarakoon A. R. W. M. M. D.[2], and Fernando S. P.[1]

[1]Marketing, Food Policy & Agribusiness Division,
Hector Kobbekaduwa Agrarian Research & Training Institute, Colombo 07, Sri Lanka

[2]Depratment of Nutrition & Food Science, University of Maryland,
College Park, USA

**Corresponding author:*
Email: kuruppu.i@harti.gov.lk

ABSTRACT

Among various inputs, seeds are inevitably critical for successful crop production, farm productivity, and profitability. Potato requires inputs intensively for its cultivation in comparison with other field crops. Only the seed accounts for more than 50% of the total cultivation cost due to the scarcity of locally produced quality seed potatoes at a reasonable price. One of the sustainable solutions to resolve this issue is to form viable Public-Private Partnerships (PPP) in order to strengthen the production of quality seed potato in Sri Lanka. In light of this, the central objective of this study is to determine the prospects in initiating PPPs to improve the production of quality seed potato in Sri Lanka. Study adopts a normative approach. Two hundred and seventy six potato farmers were selected using multi-stage random sampling covering four DS Division in Badulla and Nuwara Eliya districts. Pre-tested structured questionnaire and focus groups were deployed to gather data. Further, key informant interviews with 35 entities of both public and private entities were conducted. ANOVA was carried out to assess the cost efficiency of different seed types. Study identified that, provision of quality inputs and dissemination of technical know-how are the two main aspects expected from the PPPs. Mini tuber and Generation Zero (G0) production should be limited only to public entity while, PPP should form for production of G1 and further continuation. Build-Operate-Transfer (BOT) approach is an option for the government to outsource public projects to the private sector. This enhances the efficient resource allocation between both parties. Further, farmers could reduce total cost of production by 10% using locally produced pre-basic seeds. However, strategies should be aligned with the best possible manner in order to meet the requirement of many stakeholders.

KEYWORDS: Build-operate-transfer, Public-private partnerships, Seed potato

Introduction

Advance in agriculture sector is crucial in many developing countries around the globe since it lays the foundation for many economic activities. Public-private partnerships (PPP) are one such sustainable approach to develop agriculture sector.

Globally, agricultural PPPs are increasingly being promoted as means of improving agricultural productivity and developing sustainable agriculture (World Economic Forum, 2010). With the emergence of agricultural PPPs, attempts have been made to address issues related to seeds, machinery, agronomic practices, pest and disease outbreaks, post-harvest losses, value addition, and food security and safety (Food and Agriculture Organization, 2016). Sustainable agricultural development is a mere illusion for a developing country unless innovative research solutions and technology are incorporated to agriculture. Thus, these partnerships are designed to mediate significant barriers related to financing, initiating technical expertise, researching, and many other aspects in agriculture.

Among various inputs, seeds are inevitably critical for successful crop production, farm productivity, and profitability. Seed is the basic input in agriculture and the most important catalyst for other inputs to be cost effective. Potato is considered as one of the major food crops, and more importantly, it is the principal livelihood of farming communities in Badulla and Nuwara Eliya districts in Sri Lanka. Thus, farmers anticipate high net returns; however, the net return is lowered due to high cost of production of potato and low yield (Department of Agriculture, 2017; Department of Agriculture, 2016; Wang, 2008). Potato requires inputs intensively for its cultivation in comparison with other field crops. Only the seed accounts for more than 50% of the total cultivation cost due to the scarcity of locally produced quality seed potatoes at a reasonable price (Fernando and Premasiri, 2006; Wickramasinghe and Jayasooriya, 2012).

The annual requirement of potato is 228,000mt in Sri Lanka; however, approximately, 35% of the annual requirement is fulfilled via local production (Department of Census and Statistics, 2017; Department of Census and Statistics, 2015). To meet the local production, approximately, 15,000mt – 20,000mt of seed potatoes are required annually. Approximately 1,000mt – 2,000mt of seed potatoes are currently being produced in government farms, while another 1,000mt – 1,500mt are being imported to the country. The rest, (i.e., 80% of the seed potato requirement) is produced by farmers themselves (Babu and Merz, 2011). Of local seed production systems, farmer based informal seed systems are generally unable to maintain the expected quality, and seeds produced through such systems are easily prone to diseases. Therefore, the ultimate result could be the reduction of total productivity at national level, thereby creating an adverse environment for local potato farmer communities. Inadequate supply of good quality seeds and planting material is considered as one of the major factors contributing to the slow growth rate in the agricultural sector in the country (Udakumbura et al., 2002).

Food and Agriculture Organization, (2016) has highlighted that policies of developing countries should be directed towards fostering strong PPPs to address issues related to finance, technical know-how as well as institutional arrangements. Countries like India and China have already introduced viable PPPs in order to strengthen their local seed production. Hence, strategic PPPs could be used as an instrument to eliminate existing barriers in potato seed production in Sri Lanka and to maintain the expected production capacities. In light of this, central objective of this study is to determine the prospects in initiating PPPs to improve production of quality seed potato in Sri Lanka.

Methodology

Conceptual Framework

It is important to identify and explore the key stakeholders, their roles and responsibilities, collaborating, resource and risk sharing within the seed potato industry in Sri Lanka in order to highlight possible PPP opportunities. At the same time, better understanding of PPP is also important for its sustainable existence (Shukla and Singh, 2014). PPP is defined as a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration, is linked to performance (World Bank Group, 2018). A sound partnership allows the public sector to regulate and supervise the PPP mechanism, while allowing the private sector to play the operational role, which is provision of improved goods and services to the society.

Figure 1 illustrates some of the vital aspects of a successful PPP. It specifically consists of a sound operational model, proper risk sharing and management approach, ideal partner screening and selection mechanism and derived outputs and outcomes of the partnership venture. Operational model simply refers to how partnerships execute operations and activities to its partners. It describes people, processes, and technologies. It allows identifying clear-cut roles, responsibilities, and main functions of engaging partners. When refers to the risk element, it is important to identify how stakeholders work towards achieving a common goal, special legal and non-legal terms and agreements, levels of transparency and willingness to partnering.

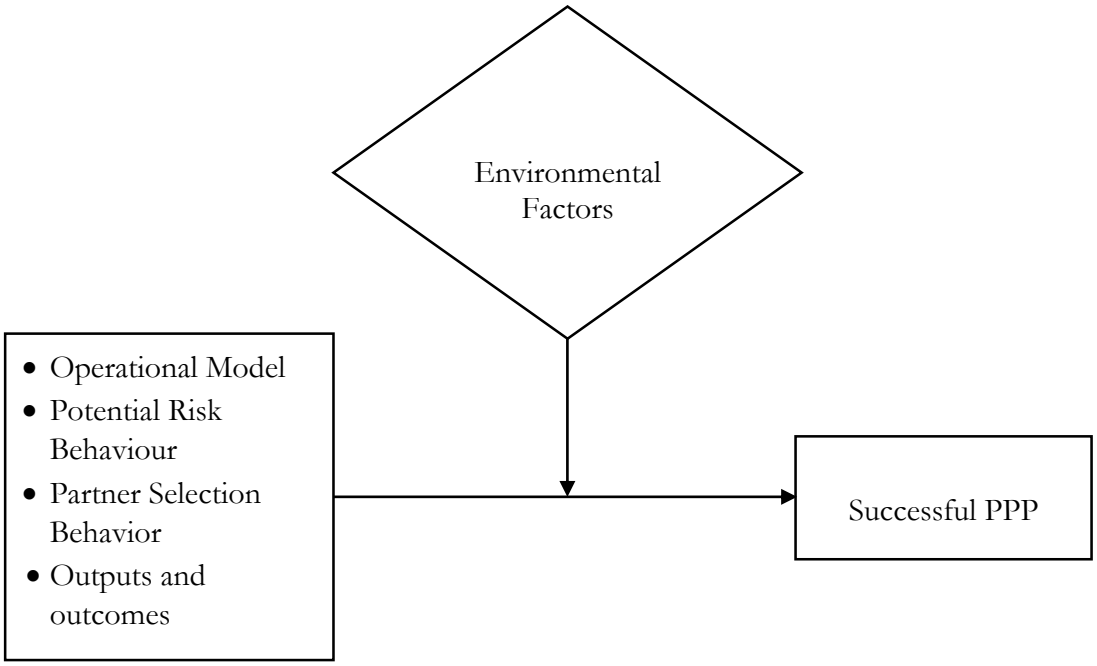

Figure 1: Conceptual Framework for Successful PPPs

Source: Authors' Compilation

Partner selection should align with the goals and objectives of the venture. PPPs are directing to achieve mutual goals (Ponnusamy, 2013). Ultimately, success is measure through outputs and outcomes of the venture. It could be either financial gains or non-financial gains. Apart from the aforementioned factors, uncontrollable factors such as environmental factors also affect PPPs. These environmental factors could differ according to the context in which the partnership operates; simultaneously, the environmental factors could be inherent to the partnership.

Study Area/s

The highest number of potato cultivation extents are located in Badulla and Nuwara Eliya districts and both areas contributed 99% to the total extent in potato cultivation in average over the past five years, from 2013 to 2017. Therefore, Badulla and Nuwara Eliya districts were selected for the study. Three DS divisions (Welimada, Uva Paranagama, and Bandarawela) were selected from Badulla district, while one DS division (Nuwara Eliya) was selected from Nuwara Eliya district based on the respective potato land extent.

Sample & Sample Selection Criteria

The total sample was comprised of key stakeholders from both public and private entities and farmers who actively engaged in the process of seed potato provision and production. Total number of 35 stakeholders was interviewed during the study. Key stakeholders were selected using a priority list according to their relative contribution and importance to the seed potato industry. Multi-stage random sampling was deployed to select farmers. A Survey was conducted using independent farmers who cultivate and produce seed potatoes. From Each DS division 69 farmers (representing nine percent from the total potato farmers in each DS division) were selected with the total sample amounting to 276 farmers.

Data Collection and Data Analysis

Both primary and secondary data were used for the study. Primary data collection was done using key informant interviews, focus group discussions and structured questionnaire. Secondary data was gathered through publications of DOA, Department of Census, and Statistics, Central Bank of Sri Lanka, relevant national and international journal articles, periodicals, and reports.

Key informant interviews were carried out for the selected stakeholders using a key informant interview guideline. Key informant interviews were conducted to elicit the current PPP details, their success or failure, challenges and barriers faced within partnerships, willingness of each parties for partnership prospects, special conditions, governance aspects, and advantages and disadvantages of partnerships. Three focus group discussions were conducted with the selected farmer groups. A pre-tested structured questionnaire was administered to collect data only from independent farmers who produce seed potatoes and cultivate potato in selected GN divisions.

Questionnaire covered social and economic status of the respondent, current crop production status, current seed potato production system/s, institutional contribution towards seed potato production, provision, and seed potato production prospects.

Both descriptive and inferential statistics were used to analyze the data. Descriptive analysis was carried out using central tendency, tables, frequency distribution etc. to elicit the prevailing mechanism of seed potato production in Sri Lanka. Next, cost comparison was conducted for different systems of seed potato production. Furthermore, ANOVA was deployed to compare each system namely, pre basic, basic, imported and other seed types[1] with respective to seed cost. Post hoc test was carried out to assess the statistically significant of different seed systems.

Results and Discussion

It is important to study and understand socio-economic factors of the studied sample since those factors could influence a particular behavior or set of behaviours of farmers' cultivation preferences. Thus, socio-economic characteristics of the farmers play a vital role in either promoting or impending agricultural production in a country (Sebatta et al., 2014). From the total sample majority (88%) of the farmers who engaged in potato cultivation were males.

When referring to the age categories of the farmers, majority (32%) was categorized under the age of 50 to 59 years. In overall, only 19% of the farmers categorized below 40 years of age (Table 1). Majority (27%) of the farmers in the sample had education up to grade six to eleven. All most all farmers had good understanding on potato varieties and pest and disease issues in potato cultivation. In addition, in some cases farmers also had knowledge on generation types. Therefore, conducting of basic training on seed potato cultivation techniques is suitable for the farmers in studied areas. In overall, from the total sample, 91% of the farmers were married and this implies that those farmers have families, which hold direct dependents. Therefore, making decisions on cultivation is critical for those farmers. Further, this may affect the possibility of retaining in the same crop or else moving to another crop or occupation. In general, majority (35%) of farm families consisted of four members.

In addition, farmers preferred to cultivate potato and vegetable combination. This is highest in Nuwara Eliya. In most cases, farmers cultivated carrot, beet, leeks, cabbage, beans, and tomato. Potato farmers were well aware of not to cultivate Solanaceae family crops (e.g. eggplant, chili, tomato, bell paper etc.) continuously with the potato. Thus, potato production in the country is highly seasonal (Agalawatte and Abeygunawardena, 1993).

[1]Pre basic seeds are the seeds which recommended to cultivate more than once per season. These include G0, G1, G2 and G3 (G denotes generation). Basic seeds are the seeds which recommended to cultivate only once per season. These includes C1 and C2 (C denotes certified). Imported seeds are the seeds which imported from other countries and recommended to cultivate only once per season. Generally imported seeds belong to Class A type.

Table 1: Selected Socio-Economic Factors of the Sample

Demographic Character	Category	Uwa Paranaga-ma %	Welimada % (n=69)	Bandarawela % (n=69)	Nuwara Eliya % (n=69)	Total % (n=276)
Gender	Female	12	20	12	6	12
	Male	88	80	88	94	88
Age	20-29	-	3	-	4	2
	30-39	16	16	9	28	17
	40-49	25	32	28	32	29
	50-59	36	29	43	19	32
	60 or <	23	20	20	17	20
Education	Grade 1-5	4	16	6	7	9
	Grade 6-11	18	32	20	29	27
	Sat for O/L	13	28	26	14	22
	Passed O/L	14	14	13	6	13
	Sat for A/L	10	6	14	33	17
	Passed A/L	9	1	17	10	11
	Graduated	1	1	-	-	1
	Diploma / NVQ	-	1	3	7	1
Marital Status	Married	96	94	84	90	91
	Unmarried	4	6	16	10	9

Source: HARTI Survey, 2018

The second highest preferable combination was paddy, potato, and vegetables. This was a prominent practice in Welimada followed by Uwa Paranagama. Farmers in these areas consider paddy cultivation is a vital factor for potato since it provides successful fallowing conditions for potato. Interestingly, farmers who engaged in paddy cultivation utilize more than 60% of their paddy harvest for domestic consumption purposes. This implies that, those farmers do not cultivate paddy for commercial purposes as their primary intention. Interestingly, in Bandarawela there is an increasing demand for cut flower cultivation. This is mainly due to exercise of irregular cultivation system, relative easiness of the cultivation and moderate-income generation by the cut flower cultivation.

Overview of the Local Seed Potato Industry

Many government actors are involved in the production of seed potato in Sri Lanka. Seed potato production starts with the tissue culture process at special laboratories at Seetha Eliya and Bandarawela Research Stations. Mother plants for tissue culture are imported from Netherlands and maintained at the facility itself. Official tissue culture process for potato in Sri Lanka is only done in these stations and interestingly no any private entities are involved in the process.

Private sector entities involve in both seed production and importation process in Sri Lanka. However, majority of private entities import seed potato in to the Sri Lanka. Thirteen private entities have been imported seed potato to the Sri Lanka since 2009. Sri Lanka has imported seed potato from six countries since 2013 and Netherlands played the vital role in the process.

In Nuwara Eliya, potato cultivation is done in early January to mid-March and the second season started from September to December. Second season in Nuwara Eliya is relatively minor than the first season. In Badulla, main season is started from June to September. The peak harvest is recorded from August to September. The first season initiated from October to early February and main objective of this season is to produce seeds, which required for the second season. This production season is also termed as "kadu kannaya" and cultivation is mainly done in higher elevations. From the total sample (n=276) purpose of majority (80%) of farmers was to cultivate potato for both seeds and for consumption. In Welimada and Nuwara Eliya DS divisions, more than 90% of the farmers cultivated potato for both seed and for consumption. Hence, these two areas are identified as established seed production areas in the country. Nevertheless, the seed production systems and cycles are different in each area. On contrary, in Badarawela DS division nearly half of the farmers produced potato only for consumption purposes. Poor keeping quality of seeds is the main reason for this particular cultivation pattern in Bandarawela.

In general, majority of farmers (59%) in all DS divisions except in Welimada have used imported seed sources as their first cultivation source. In Nuwara Eliya more than two third of the farmers adopted imported seeds as their primary seed source. Therefore, it is clear that majority were adopted "Class A" seed types which only recommended (by the Department of Agriculture) to cultivate as consumption potatoes. Notably, in Welimada more than half of the seeds were conjointly acquired through Seetha Eliya and Boralanda Research Stations and commercial level farmers in the area. In addition, out of all DS divisions government contribution for seeds was higher in Welimada. Farmers were also reasonably aware and connected with the government bodies to acquire quality seeds. This is another factor, which rationalizes higher yields in the area.

Until 1980s, government sector of Sri Lanka has sole authority over seed production and distribution in the country and in 1984 seed sector was liberalized. Since then private sector involves in seed production and dissemination. In 1996, government has introduced National Seed Policy knowing the importance of quality seeds. Moving forward, in 2003 government enacted the Seed Act No. 22 of 2003 giving more concerns to quality seeds related activities. According to the Act, seed handlers (any person who as producer, importer, distributor, conditioner, re-packager agent, or retailer is responsible for causing a seed to be placed in the market in Sri Lanka) should be registered under the Act.

G0 production is carried out using mini tubers in poly tunnels using both hydrophonic and aerophonic systems. Subsequently, G1 is produced from G0. However, not all G0 output may utilize to produce G1. A certain amount is sold to the farmers directly as well.

The rest is divided among five government farms (Meepilimana, Kandapola, Uderedella, Piduruthalagala, and Seetha Eliya) according to their capacity and requirement to produce G1. However, G0 production in Bandarawela Research Station is slightly different from that of Seetha Eliya. G0 produced in Bandarawela, is not transferred to Nuwara Eliya and only distributed to the farmers who cultivate in Badulla district. Nevertheless, seeds produced in Nuwara Eliya are transferred and purchased by the farmers in Badulla.

In some cases, G1 is further multiplied in Government farms up to C1. However, according to the situation (if there is a shortage of obtaining the previous seeds) C1 could be further multiplied to obtain C2. Therefore, normally in Sri Lanka seed potato generations such as G0, G1, G2, G3, C1, and C2 are considered as seeds and out of that G0, G1, G2, and G3 are considered as pre-basic seeds. In general, potential average yield ratio is high in subsequent generations starting from G1 to G3. Importantly, in Sri Lanka generations after C2 is not recommended to cultivate as seeds due to low vigor. Harvested seeds are initially sorted in the field manually, and then sorting is carried in the storage using a sorting machine. Machine is programmed to sort seeds, which have a diameter of 28 mm to 55 mm.

Private entities import "Class A" directly from their suppliers. Technically, "Class A" is recommended to cultivate for consumption potato since it is certified and the last generation of the classification and not for seeds. All seed potato stocks are imported in reefer containers, which are used for intermodal freight transportation in refrigerated conditions. Total duration for one shipment takes roughly about three weeks. Temperature is adjusted in each week systematically and the final temperature ranges between 16 ^{0}C and 18 ^{0}C before unload the stock to the country. Imported stocks are stored in warehouses for about one week until completion of disease tests.

Performance of the Local Seed Potato Industry

Currently, government sector as a whole produce approximately 1.2 million G0 seeds annually. At the end of 2019 government, plan to increase G0 production up to three million per annum. Currently, G0 is mainly produced using aeroponic system in 800m^2 poly tunnels. Currently station equipped with five tunnels and three cycles of production is being carried out. The total price of a G0 seed is Rs.6.00/= and 50% is borne by the government and the rest by the farmer (Cost is measured per seed not per kg) (Table 2). This program is termed as "50% contribution". For not only seeds, but also this program is expanded to establish poly tunnels in farmer filed for 50% contribution. Encouraging farmers to establish poly tunnels may also a solution to mitigate excessive use of agro-chemicals. Excessive use of synthetic chemicals and unbalanced use of inorganic fertilizers are the common practices performed by all the potato growers to maintain the productivity of their lands and profits (Eeswaran et al., 2016).

Total cost per seed includes, input, labor and electricity. However, total cost excludes tunnel maintenance and tissue culture process. Tissue culture plants are provided by the Seetha Eliya Research Station free of charge. Tunnels are used for a single crop cycle and cleaned prior to start the next cycle. Fumigation is carried out only if there are any possible threats.

Table 2: Cost per Seed (G0) for Different Poly Tunnel Systems in Government Farms

Adopted System	Unit Price (Rs. per seed)
Aeroponic	1.80
Hydrophonic	2.90
Geophonic	4.00

Source: HARTI Survey, 2018

Furthermore, target of producing 45mt. of G1 in poly tunnels at the end of 2019 is also been recognized. Twenty poly tunnels are already constructed in Seetha Eliya farm to ensure continuous G1 production and currently 12 poly tunnels are at the operational level. The rest is planned to function in the end of 2019. All poly tunnels adopt a geophonic system, and media includes paddy husk and tea reduce. It has been estimated that, 1,500 kg of G1 production from one poly tunnel, total of 30mt. from all 20 poly tunnels may release per annum only from the Seetha Eliya farm. Accordingly, from the total G1 output, exactly 50% is allocated for farmers and the balance is remained in the farms to produce G2. Programs which conducted by the Provincial Agricultural Departments are aimed to produce 600 G0 seeds within the area of 25 m^2 and multiplied it to obtain G1. This output of G1 is enough to cultivate in 0.25 acres. Likewise, this rotation is continued subsequently for 3 – 4 times.

Based on the results of the ANOVA (Table 3, Table 4), seed cost is significant according the seed type which used by the farmers. Cost of pre basic seed is significantly different from other three types. Interestingly, Rs.103, 467 difference for seed cost per acre is observed between the imported and pre basic seeds. Further, farmers could save Rs.79, 237 per acre from seeds if they opted basic seeds over imported seeds. Cost of basic seed and other seed types are not statistically significant.

Table 3: ANOVA for Seed Cost of Different Systmes

Source	Sum of Squares	df	Mean Square	F	Sig.
Gender	3.335×10^{11}	3	1.112×10^{11}	1.112×10^{11}	0.000
	4.445×10^{10}	219	2.030×10^{8}	2.030×10^{8}	
	3.779×10^{11}	222			

R Squared = 0.882 (Adjusted R Squared = 0.881)

Hence, promotion of local seed potato production is encouraged. If a farmer uses pre basic seeds, it is only 42% from the total cost of production and more importantly, that farmer could cultivate consecutive seasons using same produce as seeds. Farmer could reduce total cost of production by 10% compared to using of imported seed potatoes.

Table 4: Multiple Comparison of Seed Cost of Different Systems

(I) Seed Type	(J) Seed Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Basic	Imported	-79237.46*	2840.15	0.000	-86590.24	-71884.68
	Other	-4067.80	3998.87	0.740	-14420.36	6284.75
	Pre Basic	24229.16*	4505.14	0.000	12565.95	35892.37
Imported	Basic	79237.46*	2840.15	0.000	71884.68	86590.24
	Other	75169.66*	3244.47	0.000	66770.14	83569.18
	Pre Basic	103466.63*	3851.22	0.000	93496.33	113436.93
Other	Basic	4067.80	3998.87	0.740	-6284.75	14420.36
	Imported	-75169.66*	3244.47	0.000	-83569.18	-66770.14
	Pre Basic	28296.96*	4770.37	0.000	15947.11	40646.82
Pre Basic	Basic	-24229.16*	4505.14	0.000	-35892.37	-12565.95
	Imported	-103466.63*	3851.22	0.000	-113436.93	-93496.33
	Other	-28296.96*	4770.37	0.000	-40646.82	-15947.11

****Significant at 1% level, **Significant at 5% level, * Significant at 10% level*

The Second highest concern was given on dissemination of technological expertise related to seed potato industry. Specially, new techniques of producing seeds. Technical aspects and training related to Mini tuber and G0 production in poly tunnels is the best example for this. Since this is a highly sensitive and technical aspect, it should be limited to the public sector entities. However, this is not commercially feasible for large-scale private entities since there is a limited demand and only use by certain group. However, G0 production could be strengthen by introducing it only to selected farmer groups with poly tunnel facility with strong supervision. Quality of seed could be assured in this way.

Public sector could continue 50% subsidy program for both seeds and poly tunnels for those selected farmers with the required extension and monitoring services. Buyback system could be applied for partial harvest to evade storage issues and to increase the production of G1 in the government farms since G0 output produced by the research stations is not adequate. Public and private entities could possibly form a viable partnership to construct poly tunnels and to expand G1 production. Build-Operate-Transfer (BOT) approach is an option for the government to outsource public projects to the private sector. In this approach, private entity receives concession for a fixed period from the public party for the development and operation of a public facility. The development consists of the financing, design, and construction of the facility, managing and maintaining the facility adequately, and making it sufficiently profitable. The private entity secures return of investment by operating the facility, during the concession period, and as the owner. At the end of the concession period, private entity transfers the ownership of the facility free of liens to the public entity at no cost. This approach is very much useful to share risk between the parties, which considered as a vital aspect of a PPP.

If production flows seamlessly, then secondary aspects like storage facilities are required to hold buffer stocks and surpluses. However, maintaining such facilities are costly and willingness of commercial level private entities to build those types of facilities are at less concern. However, study revealed that cold storage facilities should only construct for large scale and active famer groups. In such cases, two options are available for the public sector. Either public entity could extent 50% subsidy or else 100% financial contribution to construct the facility. However, in both options maintenance including utility cost should be transferred to the specific famer group to make it a realistic investment. Capacity ranging from 50mt to 100mt is more than adequate for this purpose.

Conclusions

Survey revealed some important concerns on seed potato production in Sri Lanka. It is clear that, no entity could withstand alone in the industry without the aid and contribution of other entities. Hence, best way is to consider all ideas of all stakeholders and plot strategies only for the feasible ones. However, strategies should be aligned with the best possible manner in order to meet the requirement of many stakeholders. Thus, best way to strengthen local seed potato production is to form viable PPPs. Even though Sri Lanka has PPPs for other sectors, agriculture has only limited number. Therefore, PPPs in seed industry is vital. Another aspect is that Sri Lanka should strengthen its National Seed Policy. It is also revealed that, the current Seed Act is not best fit for PPP formation since it does not create a risk sharing mechanism and other related aspects related to PPPs. BOT approach is ideal to reform available resources within both public and private entities. Such applications are proven in other countries like India and China. However, one should understand that this strategy does not imply 100% production or self-sufficient level in seed potato in Sri Lanka.

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