PRESENT SITUATION AND FUTURE POTENTIAL OF CASSAVA IN INDIA

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ABSTRACT

Cassava (*Manihot esculenta* Crantz.) is cultivated in India in about thirteen states (out of 32 states and union territories) with major production in the South Indian states of Kerala (142,000 ha) and Tamil Nadu (65,700 ha). It is now a major industrial crop in Tamil Nadu and is also gaining importance in Andhra Pradesh. The area and production trends of cassava in India and the major constraints to cassava production are highlighted in this paper. The emerging trends in cassava production, like the true cassava seed program, organic manuring, mycorrhizal technology, etc., and the strategy adopted in India to contain cassava mosaic disease, are briefly discussed. The efforts made to popularize high yielding varieties in traditional areas, and to expand cassava cultivation to non-traditional areas where the poverty stricken rural people make up a major share of the population, are also detailed. The transfer of cassava production technology is done through specific outreach programs of the Institute, namely the Lab-to-Land Programme, Institute Village Linkage Programme and Farmers Seminars. A special program, called "Testing and popularising cassava varieties", is currently undertaken in Tamil Nadu. The production and processing technologies are also transferred through consultancies, as in the case of Project Uptech (in Andhra Pradesh … 21,000 ha of cassava), in which a partnership is established with the State Bank of India.

The technological advancement made in the field of cassava utilization and the diversified value-added products that can be made from cassava are described. Realizing the industrial importance cassava is likely to attain in the next 20 years, priorities for future development have been identified. While attempting to augment internal demand by developing and marketing value-added products and increasing the use of cassava in poultry and fish feeds, opportunities for export markets need also to be explored. Some of the imminent problems faced by the cassava starch industry, and efforts being made to address these issues, are narrated. The need for setting up rural agro-enterprises based on cassava as well as organized marketing channels for the roots to ensure a reasonable income for producers, human resource development through international collaboration, the role of participatory research in solving farmers' problems, etc. are also discussed.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz), which was introduced into India by the Portuguese during the 17th century as a food crop, is gradually changing its role as an industrial raw material. The importance of cassava as a food crop was well recognized in Kerala, south India during the 20th century, when famine struck India at the time of the Second World War. The crop integrated well with the traditions and culture of the people of Kerala. Adaptability to poor soils, an ability to establish in high as well as low rainfall areas, and relative resistance to pests and diseases are a few of the factors that helped to anchor cassava in India. With increasing availability of cereals and other food materials, the food value of cassava gradually diminished. Meanwhile, cassava spread to the neighboring states of Tamil Nadu and Andhra Pradesh, where it serves mostly as raw material for starch extraction. The phenomenal growth in the starch and sago trade over the years has also helped in creating rural employment in Tamil Nadu.

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PATTERN OF GROWTH IN CASSAVA CULTIVATION

Asia stands second among the cassava-producing continents in the world. Approximately 13% of Asian cassava production comes from India. **Figure 1** shows the trend in cassava area, production and yield in India during the past four decades. Cassava area and, particularly, production increased steadily from 1963 to 1977, after which both declined. Production has been maintained at about 5.5 million tonnes due to a steady and remarkable increase in yield, from 7 t/ha in 1963 to 24 t/ha in 2000.

Although cassava is cultivated in about 13 states of India, major production is from the southern states of Kerala and Tamil Nadu. As a result of changing life-styles, the influx of money sent home by Indians working in the Gulf states, and a shift to cultivation of cash crops like rubber and plantation crops, the area under cassava in Kerala has gradually decreased over the past 30 years (**Figure 2**). Cassava, which was planted in an area of 297,000 ha in 1967/68 was cultivated in only 142,000 ha in Kerala in 1996/97. The industrial potential of cassava, however, has led to a rapid spread of cultivation in Tamil Nadu, and complementary factors for its growth have been the cheap labor available in that state and the organized marketing channels for the products. While the total production in Kerala declined to 2.59 million tonnes in 1996/97 from 4.2 million tonnes in 1967/68, in Tamil Nadu cassava production rose to 3.04 million tonnes in 1996/97 from 0.42 million tonnes in 1967/68 (**Figure 2**). The remarkable increase in production in Tamil Nadu is due to the very high productivity of cassava in that state (about 46.32 t/ha in 1996/97), which is the result of adoption of high-yielding cultivars like H-165 and H-226 as well as better management of the crop through the use of irrigation (**Table 1**). The shift in focus of the crop from Kerala to Tamil Nadu is also evident from the percentage contribution of the two states towards national cassava production over the past thirty years. Kerala, which accounted for 86% of the total area and 91% of total production in 1967/68 contributed only 61% and 45%, respectively, towards area and production in 1996/97 (**Figure 2**). By contrast, Tamil Nadu which had only a meager area (13%) and production (9%) in 1967/68, contributed 29% of the total cassava area and 52% of total cassava production in 1996/97. Based on statistical projections, the production of cassava in Tamil Nadu is expected to reach 6.08, 6.76 and 7.44 million tonnes, respectively, by the years 2000, 2010 and 2020.

Considering the population growth rate, India needs to produce as much cassava roots as 12 million tonnes by the year 2020; this calls for R&D strategies to meet the requirement. The present productivity of 22.5 t/ha is projected to rise to 26.95, 32.57 and 38.20 t/ha by the years 2000, 2010 and 2020, respectively.

SWOT ANALYSIS

SWOT analysis is an important tool which analyzes the *strengths*, *weaknesses*, *opportunities* and *threats* of any enterprise while formulating development strategies for that enterprise. The salient points from a SWOT analysis on cassava in India are furnished below:

Strengths

1. Potential to produce a large amount of food per unit area
2. Excellent adaptability to a wide range of ecosystems
3. Relatively free from pests and diseases
4. Strong cassava research base available
5. Strong technology base
6. Capability in providing food security and contributing towards livelihood.

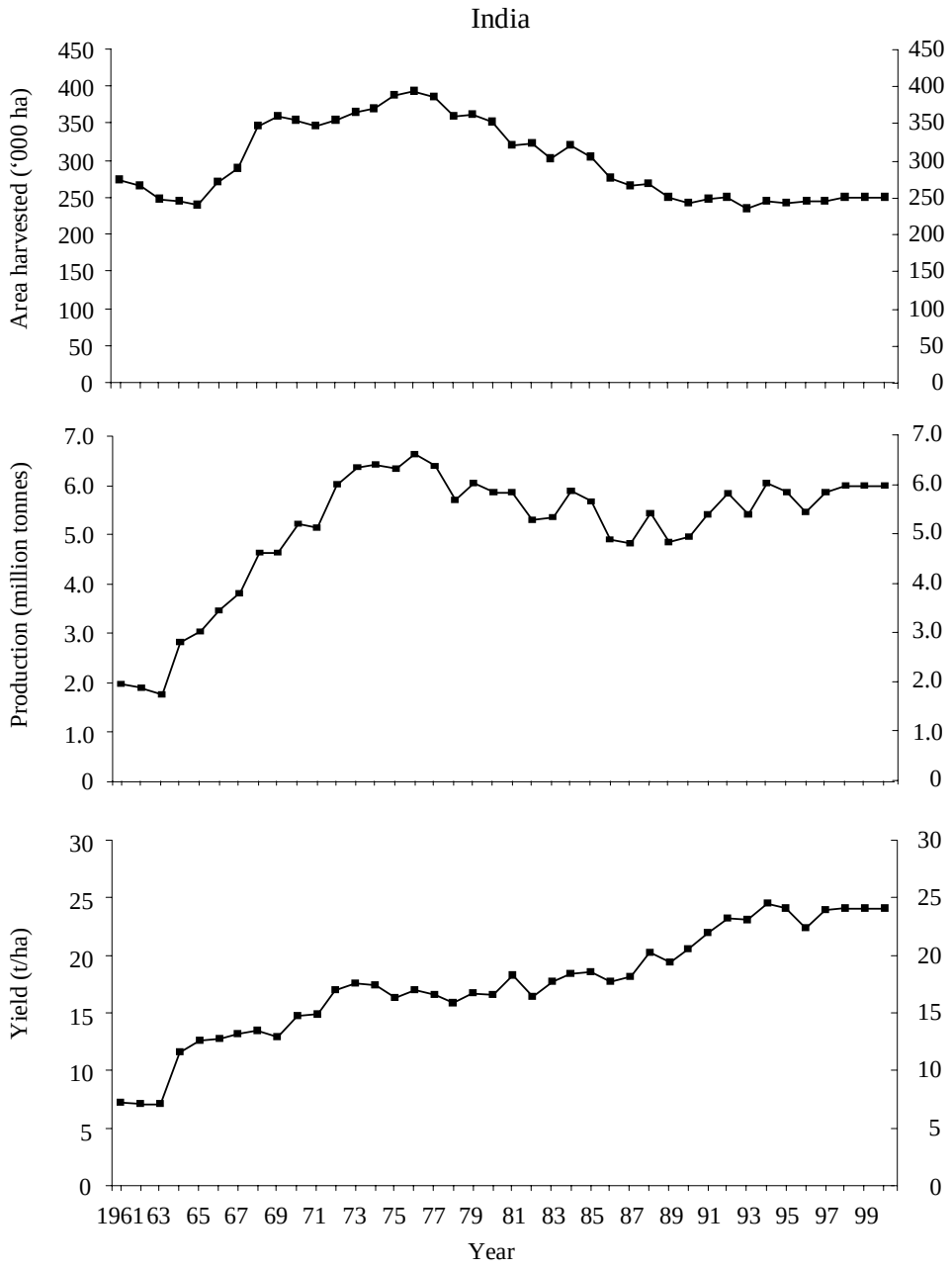

Figure 1. Cassava harvested area, production and yield in India from 1961 to 2000.

Source: *FAOSTAT, 2001.*

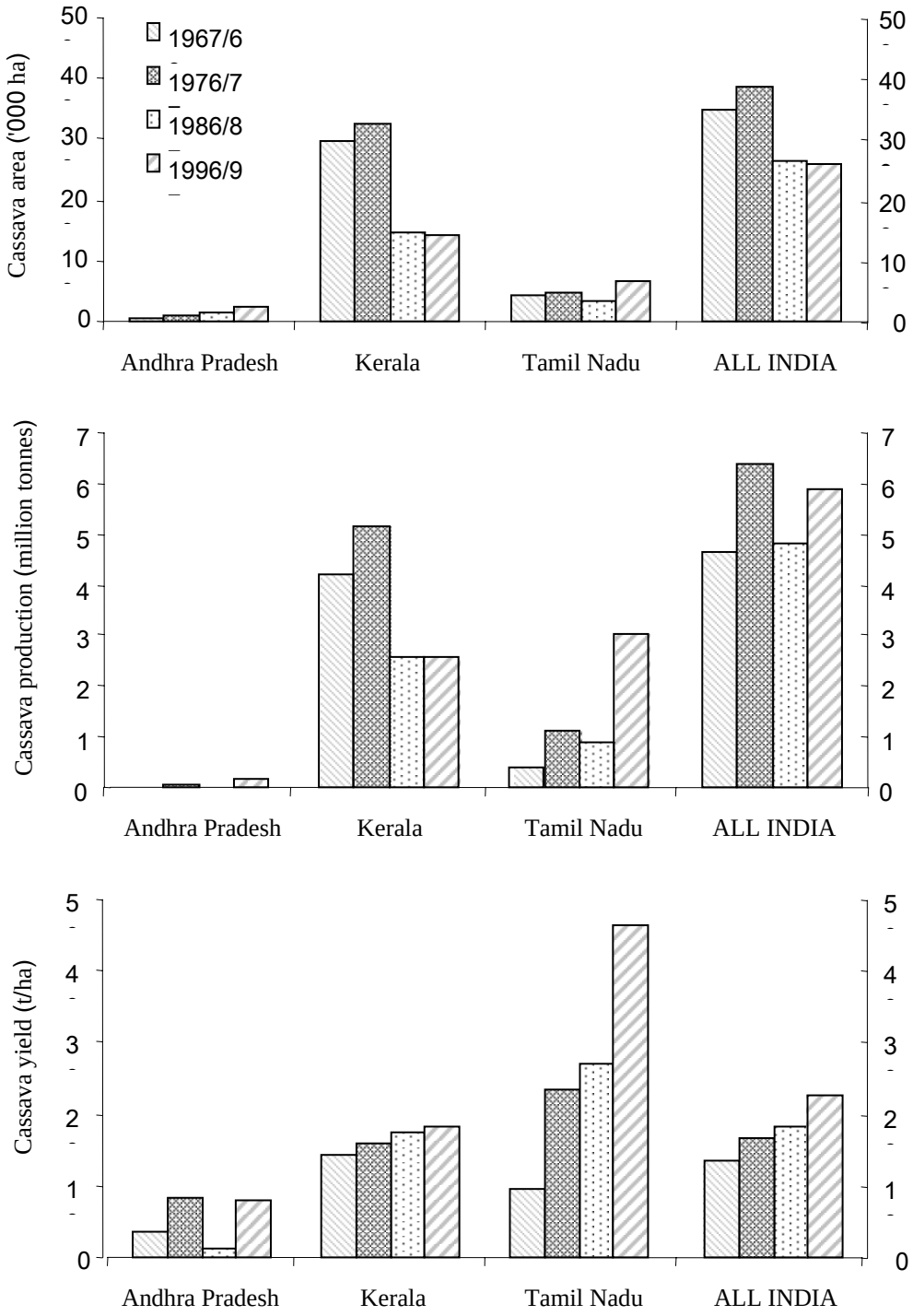

Figure 2. Changes in cassava area, production and yield in the main cassava production states of India from 1967/68 to 1996/97.

Table 1. Area, production and yield of cassava in India (1967/68 to 1996/97).

State	Area ('000 ha)				Production ('000 t)				Yield (t/ha)			
	'67/68	'76/77	'86/87	'96/97	'67/68	'76/77	'86/87	'96/97	'67/68	'76/77	'86/87	'96/97
Andhra Pradesh	3.40	9.00	12.50	22.00	12.20	74.10	15.20	174.50	3.59	8.23	1.22	7.93
Assam	2.10	1.30	1.78	2.40	9.60	5.40	7.50	11.50	4.57	4.15	4.24	4.79
Karnataka	0.60	1.20	1.50	0.90	4.10	16.60	14.60	7.10	6.83	13.83	9.73	7.89
Kerala	297.60	323.30	146.95	142.00	4198.40	5125.50	2576.10	2588.30	14.11	15.85	17.53	18.23
Meghalaya			4.00	3.90			23.30	21.50			5.83	5.51
Nagaland			0.30				0.60				2.00	
Rajasthan			0.20				0.50				2.50	
Tamil Nadu	43.40	48.00	33.80	65.70	419.40	1128.20	913.40	3043.20	9.66	23.50	27.02	46.32
Tripura		0.20	0.50			0.60	2.15			3.00	4.30	
A & N Islands			0.20				0.80				4.00	
Arunachal Pradesh			3.20				10.00				3.13	
Mizoram		0.10	0.10			0.30	0.50			3.00	5.00	
Pondicherry		0.70	0.50			13.40	9.90			19.14	19.80	
ALL INDIA	**347.10**	**386.00**	**265.00**	**260.80**	**4643.70**	**6375.00**	**4814.00**	**5868.30**	**13.38**	**16.52**	**18.17**	**22.50**

Source: *Lakshmi et al., 2000.*

Weaknesses

1. Cassava is not given due recognition in agricultural development policies of the government
2. Lack of extension programs
3. Lack of organized marketing
4. Disproportionate increase in the labor wage and root price
5. Lack of information base
6. Poor resource base

Opportunities

1. Role in food security
2. Scope for area expansion
3. Product diversification
4. Suitability for use in various cropping systems

Threats

1. Decline in area
2. Product *cum* price competitiveness
3. Competition from other exporting countries

CASSAVA PRODUCTION

While the average world cassava yield is only 10 t/ha, the yield in India is currently 22.5 t/ha. This has been possible mainly through the introduction of high-yielding cassava varieties, released by CTCRI, and the adoption of improved production practices. Despite this, there are a number of biological constraints to cassava yield improvement. These include a low multiplication rate, bulky planting material required for cultivation, rapid drying out of stakes, and incidence of cassava mosaic disease (CMD) and root rot. It is important to address these issues through properly oriented research programs, so that the high productivity can be sustained. One of the most fascinating strategies to overcome the low multiplication rate and bulkiness of planting material is the true cassava seed program (TCSP). Work on TCSP was initiated in India almost a decade ago, and has advantages such as a 150 times increase in propagation rate, longer viability of seed, and non-transmission of mosaic virus through seed. Cassava mosaic disease is gradually reaching alarming proportions in the cassava-growing states of India. The integrated disease management strategy adopted to overcome this biological constraint includes production of disease-free material through meristem culture, multiplication of planting material in vector-free zones, mass multiplication of healthy planting material through farmer participation, etc.

The shift in focus of cassava from a food to an industrial crop has led to a change in the breeding strategy for cassava as well. For the industrial zones of Tamil Nadu and Andhra Pradesh, importance is being given to develop high starch varieties with CMD tolerance, early harvestability and better post-harvest storage life.

Management strategies to improve cassava production include agronomic interventions, such as the development of low input and mycorrhizal technologies, natural resource utilization and water management. As a management strategy for CMD, branching types are also preferred due to better canopy spread with consequently lower yield reduction from the disease. Testing and popularization of cassava varieties through outreach programs like the Lab-to-Land Program (LLP), Institution-Village Linkage Program (IVLP) and on-farm trials (OFT) are another approach for enhancing cassava production.

PROCESSING AND UTILIZATION

Cassava offers immense scope as a food, feed and industrial raw material. An overview of the global product use of cassava indicates that the roots are the source of a number of fermented food products in Africa and Latin America as well as non-fermented food products in Asia. Even though substantial proportions (>30%) of cassava are used for on-farm pig feeding in Vietnam and China, its use as cattle feed in India is still very limited. More than three and a half decades of cassava research at CTCRI has led to the development of several utilization technologies. Some of these are the production of alcohol, cold water soluble starch, biodegradable plastics, food products like *rava* (semolina) and porridge, glues and adhesives, as well as *in situ* utilization as ensiled cassava for cattle, microbial techniques to enhance starch recovery, and starch factory waste-based broiler feed.

Starch and sago are the two cassava products that have revolutionized cassava cultivation in Tamil Nadu. There are a number of lessons that can be learnt from the experience of Tamil Nadu, where cultivation and organized marketing channels have raised the hopes of cassava farmers. The fact that cassava can offer sustainable incomes to farmers has encouraged them to cultivate the crop even by using irrigation to obtain good returns. About 80% of the national demand for starch and sago is met by approximately 1,100 starch factories in Tamil Nadu, which produce 150,000 tonnes each of starch and sago from 1.5 million tonnes of roots. The remaining quantity of roots goes mainly for cassava chips, flour, cattle feed, wafer production and for consumption of raw tubers for human consumption and animals. Starch/sago production has now spread to the adjoining state of Andhra Pradesh as well, where the production is about 25,000 tonnes of sago and 5,000 tonnes of starch. Starch and sago production from India is projected to reach 0.4 and 0.3 million tonnes, respectively, by the year 2020.

Expansion of cassava cultivation to non-traditional areas is an alternate strategy adopted by CTCRI to enhance cassava production in India. As a part of this strategy, a novel project termed UPTECH was launched in Andhra Pradesh in 1998 with the collaboration of the State Bank of India. The technical support extended under this program includes preparation of a feasibility report on the modernization of starch/flour industries, consultancies for process development, treatment of waste water, and refinement of agro-techniques.

PRODUCTS OF FUTURE POTENTIAL

In order to maintain equity in the food production systems, secondary crops like cassava have to be retained in the cropping systems of marginal farmers. This necessitates the creation of awareness of the scope of cassava for *in situ* production of several food products through rural processing units. A number of products like wafers, chips, *pappads*, *rava*, noodles and dried chips for animal feed can be made with low technological and financial inputs. Converting harvested cassava to products with better storability will help farmers reduce postharvest losses and ensure economic returns. Stable quality value-added products made from cassava can also open up export avenues for cassava.

Starch and sago will continue to be the major industrial products from cassava in India. Nevertheless, the commercial success of any industry depends on the diversified products generated. Realizing this, two hi-tech starch factories have recently been established in the Erode and Dharmapuri districts of Tamil Nadu to start manufacturing several modified starches from cassava. These include pre-gelatinized starch (for the paper and oil industries), acid-modified thin boiling starch (for the confectionery and textile industries), oxidized and cationic starches (for the paper industry), textile grade modified starch with good tensile and adhesive strength (for the textile industry), and paper grade

starch with ink water resistance. Such products, besides augmenting internal demand, are likely to improve export potential also.

Although, cassava-based products were exported by India to European countries from 1958 to 1964, these exports stopped subsequently when internal demand increased. In 1996, India exported 31,000 tonnes of cassava products earning Rs 141.30 million of foreign exchange (**Tables 2** and **3**). Irregular demand and an inability to compete with international prices did not allow this trade to catch momentum. With a view to promoting the export potential of cassava-based products, CTCRI has launched programs such as market assessment and export demand assessment. Extruded food products and white pelleted starch conforming to international quality standards are products of future potential for India. Strengthening the research base to produce modified starches with stable viscosity, freeze-thaw stability, film-forming properties, better suspension characteristics, etc. to suit many food applications (Satin, 2000) will further enhance the prospects of cassava in India.

A number of problems were faced by the cassava cultivators of Tamil Nadu when the crop was introduced into the state. Lack of market avenues and poor post-harvest storage life of roots dismayed their aspirations. Realizing this, an industrial cooperative society, called SAGOSERVE, was established by a group of entrepreneurs. This cooperative is at present monopolizing the starch and sago trade in the state. In addition, it has also substantially enhanced rural employment opportunities, resulting in around 0.6 million people making a living from cassava. The marketing channel for cassava in Tamil Nadu is well organized with a central role being played by SAGOSERVE. The lack of such an organization was felt by the producers of Andhra Pradesh, and an industrial cooperative society of a similar nature to SAGOSERVE was launched in the state in February, 2000. Exploitation of farmers by middlemen and processors can be controlled to a large extent through the intervention of such societies.

PRIORITY ISSUES AND FUTURE NEEDS

The declining importance of cassava as a food crop in India, shrinkage in cultivated area, long crop duration, diseases like CMD and root rot, necessitate alternative research strategies to diversify the scope of cassava utilization and to sustain its production and productivity in India. Germplasm enrichment through exchange (in tissue culture) can help introduce root rot resistant, drought resistant and high starch cassava varieties from Brazil, or early maturing and high dry matter clones from countries like Thailand. Proposed research collaboration with CIAT is expected to make available true seeds of elite high starch clones and to facilitate the generation of sustainable production management practices in India. Human resource development through training programs with the active participation of international agencies is also necessary to strengthen the research base to tackle vital issues related to production and product development.

The cropping pattern scenario has witnessed change, especially in Kerala where plantation crops have started gaining prominence in upland production. This necessitates cassava to be integrated into alternative cropping systems, such as lowland and multi-tier systems. Thus, there is a need to develop management practices for cropping systems involving cassava in upland and lowland production systems.

Cassava is grown under many complex and diversified production systems where technology preferences are multifarious to suit different socio-economic production systems and objectives. It is necessary to have technology assessments under a wide range of agro-climatic situations through farmer participatory research.

Table 2. Exports of cassava and its products from India during 1996/97.

Cassava Product	Importing country	Quantity exported (tonnes)
Cassava flour and meal	Australia	3.0
	Baharain IS	1.8
	Bangladesh	685.8
	Canada	0.3
	Hongkong	0.1
	Kenya	19.0
	Kuwait	15.5
	Mozambique	1.0
	New Zealand	0.8
	Oman	2.3
	Saudi Arabia	8.7
	Sri Lanka	3.0
	Tanzania Rep.	0.5
	UAE	23.0
	UK	28.0
	USA	41.4
	Zambia	1.0
	China P Rep	196.0
	Malaysia	294.0
	Sri Lanka	138.2
	Total	**1,463.7**
Cassava starch	Bangladesh	977.4
	Malaysia	598.8
	Russia	20.0
	Sri Lanka	533.8
	Thailand	18.0
	UAE	0.4
	USA	4.0
	Total	**2,152.5**
Cassava (tapioca) & substitutes prepared from cassava starch	Bangladesh	705.8
	Belgium	4,810.0
	Italy	22,500.0
	Singapore	5.0
	South Africa	84.5
	Sri Lanka	60.0
	UAE	72.5
	Total	**28,238.3**

Source: *Directorate of Commercial Intelligence and Statistics, 1997.*

Table 3. Quantity (tonnes) of starch and sago marketed in India.

Commodity	Year	Marketed through SAGOSERVE	Direct sales	Total
Starch	1997/98	75,654	18,913	94,507
	1998/99	72,000	18,000	90,000
Sago	1997/98	105,767	43,203	148,970
	1998/99	112,500	42,750	155,250

Note: Direct sales make up 25% of SAGOSERVE's sales per annum in the case of starch and 20% in the case of sago in Tamil Nadu, plus 22,050 tonnes per annum of sago from Andhra Pradesh.

Source: *SAGOSERVE, 1998.*

In view of the global development strategy for cassava initiated a couple of years back, there is also a need to start an Asian Cassava Production and Processing Network (ACPPN) to identify the needs of Asian countries, their strengths and weaknesses, as well as to strengthen mutual development. It can also help coordinate the research activities of member countries. For example, low genetic diversity is a major hurdle in cassava improvement for countries like Vietnam and China. By contrast, India has a rich germplasm collection of cassava which can be made available to these countries. Diversification technologies developed in India can also benefit countries like Thailand, which has had to increase internal starch demand in recent years due to a decline in export markets. The wet starch technology of Vietnam and that of pelleted cassava of Thailand can in turn help India expand the utilization potential of cassava in the industrial and animal feed sectors. Network collaboration seems to be the right choice for Asian countries to widen the prospects of cassava in the coming decades.

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