PRODUCTION SYSTEM TYPOLOGY AND TECHNOLOGY UTILIZATION PATTERN IN CASSAVA CULTIVATION IN THIRUVANANTHAPURAM DISTRICT

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Thesis submitted in partial fulfillment of the requirement for the degree of

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DECLARATION

I hereby declare that this thesis entitled "**Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other university or society.

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CERTIFICATE

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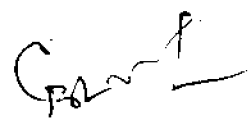

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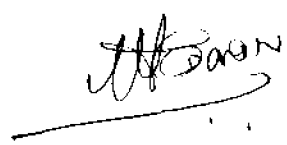

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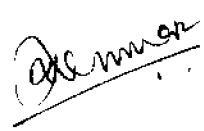

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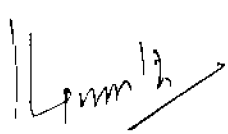

Dedicated To

My Dear Parents

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Introduction

1. INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a tropical tuber crop, globally known as famine crop which forms an important alternate source of energy to meet the demand of the geometrically increasing population (Edison, 2001). This strange looking tropical crop is believed to be originated in Brazil and Paraguay (Nassar, 1978). It was introduced to India by the Portuguese during 17th century. The cultivation of the crop was encouraged by the ruler of erstwhile Travancore State Sree Visakom Thirunal in 18th century. It is widely believed that cassava helped in starving off famine in the state during second world war (Rangaswami, 1986). The Spanish also introduced it to the Philippines and it is now grown in large areas of Africa, Asia and Central America. It has ability to grow in a wide range of soil and climate of the tropics and subtropics from dry and summer situation to shaded and water logged condition (Ghosh *et al.*, 1988).

All the species of the genus Manihot are sun loving. It tolerates drought and low fertility and is primarily grown and eaten by small farmers in areas with poor soil or unfavaourable climates. It requires minimal fertilizers, pesticides and water. In general cassava can be harvested any time from 6 to 12 months after planting. It can be left in the ground as a safeguard against unexpected food shortages.

It has the potential to produce highest dry matter per day, a major calorie contributor and has capacity to withstand adverse biotic and abiotic stresses. Ananatharaman and Nair (1999) reported that cassava can contribute food security to weaker sections.

This tuber crop is the third important crop in the list of 30 essential food crops prepared by FAO (1989), cereals and legumes being the first and second essential crops. Cassava is grown in an area of 16.37 million

hectares globally with an annual output of 164.75 million tonnes of tubers. Nigeria occupies the first position in area under cassava. It accounts for 16.5 per cent (2.70 m ha) of the world area producing 18.5 per cent (30.47 mt) Congo (2.1 m ha), Brazil (1.91 m ha), Thailand (1.26 m ha) and Indonesia, producing 64 per cent (105.44 m tonnes) of the total world production (Ramanathan and Anantharaman, 1996).

Cassava is concentrated mostly in the Southern Peninsula region of India covering Kerala, Tamil Nadu and Andhra Pradesh. Prior to the population of cassava as an industrial crop in Andhra Pradesh, it was cultivated as a food crop by the tribal farmers of the East Godavari district. Srinivas *et al.* (2002) reported that cassava is the crop of subsistence for majority of weaker sections of farming community especially in the traditional strong hold of Kerala.

In India cassava is cultivated in 0.24 m ha, producing 6 mt. Kerala where the crop was first introduced accounted for 50 per cent of the total national area under cassava (0.13 m ha). Tamil Nadu accounts for 43 per cent (0.10 m ha). Though India's position in production is seventh in the world, its productivity is the highest (24.5 t ha^{-1}). There is a need for improving the productivity, so as to meet the food needs of the consistently growing population (Edison, 2001).

Cassava is cultivated under complex diversified and risk-prone production system in India excepting Tamil Nadu where it usually enjoys the privilege of well-endowed production system. The study of Ramanathan *et al.* (1991) revealed that more than 13 per cent of total area of cassava in Kerala is under lowland. The major production system typologies of cassava in Kerala are pure crop, mixed crop, intercrop and homestead, whereas in Tamil Nadu and Andhra Pradesh it is cultivated as irrigated sole crop year after year in the same field or as an intercrop under coconut plantation. It is estimated that the extent of inter mixed cropping in coconut is 78 per cent and that cassava occupies about 20 per cent of land in

the coconut plantations of Kerala. In Tamil Nadu 65 per cent of the coconut gardens are intercropped with cassava and sorghum (FIB, 2002).

It has been observed that there is a considerable decline in areas of cassava in India in the last two decades. The cassava area of 3.9 lakh ha during 1975 has declined to 2.7 lakh ha in 2001 registering a negative growth rate to the tune of five per cent. The major factors contributing to this plight, the increasing availability of cereals, coupled with organized distribution system and crop preference of farmers in favour of commercial and less labour intensive crops like rubber, coconut etc. Cassava faces stiff competition from other remunerative crops and this reasons for decline in area. There is no well defined government policy for the enhancement of cassava cultivation and there is no adequate scheme for distribution of planting materials on a large scale and training programmes for imparting scientific knowledge on cassava cultivation to farmers, farm women, entrepreneurs etc. Lack of regulated marketing systems for the prompt disposal of cassava, inadequate infrastructure facilities for industrial scope are some of the other major reasons for the decline in area under cassava cultivation in Kerala.

Certain constraints are inherent in the production and processing of cassava cultivation. These include the lengthy growing season. Cassava requires ten months from planting to harvest but can vary between 6 to 24 months depending on climatic and soil conditions. Other constraints are low multiplication rate, nature of bulky planting materials, lack of sufficient good quality planting material, non availability of inputs in time, exclusive prevalence of pest and diseases, lack of awareness and knowledge about high yielding varieties of cassava, high cost of inputs, labour scarcity, inadequate research and extension support, inadequate information about improved cassava cultivation, lack of credit facilities, high labour charges, inadequacy of capital, high transport charges, lack of

marketing facilities, highly perishable nature of cassava tubers and lack of storage facility (Spencer and Kainaneh, 1997).

It is also identified that some socio-economic constraints of farmers such as age, years of formal education, experience, membership of producers and processors in co-operatives or associations are affecting technology adoption and cultivation of cassava (El-Sharkawy, 1993). In addition to these policy and institutional constraints such as investment in and orientation of research and development, absence of cassava lobby, access to credit, access to markets are some other major constraints which are hindering the prospects of production and processing of cassava.

Cassava farmers, majority of whom belong to small and marginal category with poor resource base, are neither organized nor have any forum or association to put forth their voice before the policy makers. This has often resulted in low utilisation of improved technologies as well as low income to farmers who depend on cassava for their livelihood. The wide range of technology gap is observed among cassava farmers due to the unorganized nature and poor resource base.

In order to bridge the technology gap, detailed information on technology utilization pattern by cassava farmers is indispensable. Information on cassava technology utilization pattern and production system typology will indicate the significance of imparting training to the farmers, for which their training needs have to be ascertained. In production and processing of cassava several improved and advanced technologies have been generated. But there is a wide gap between available technologies and their adoption by farmers. In order to bridge this gap, framing appropriate development strategies for cassava, besides upgrading the technical competency of extension personnel is necessary. The detailed information on technology utilization pattern by cassava farmers is also indispensable for minimizing the technology gap. The

identification of various production system typology will help to increase production and productivity of cassava.

Annamalai and Anantharaman (1978) stated that training to cultivators in the scientific methods of crop production and processing, if universally employed can double the current level of yield. He also stated that in India if the farmers were activated to use modern techniques through training food deficiency would be wiped out.

Hence the present study on production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district is designed to assess the various production system typologies of cassava, technology gap, technology utilization pattern, reasons for decline in area under cassava cultivation, constraints in cassava cultivation and training needs of farmers on production and processing of cassava.

Objectives

1. To study the profile characteristics of cassava cultivators
2. To find out the cassava production system typologies
3. To assess the technology utilization pattern of cassava farmers
4. To identify the technology gap in cassava cultivation
5. To identify the constraints in the cassava cultivation
6. To identify the reasons for decline in the area under cassava cultivation
7. To assess the training needs of farmers in cassava production and processing technology

Scope and Importance of the Study

A detailed study of production system typology, technology gap and the utilization level of cassava technologies would help us to

understand the present status or cassava cultivation. This information would be useful to develop suitable extension strategies to further increase the knowledge and utilization levels in improved production technologies in cassava.

Limitations

The study had the limitations of time and sample size. Hence it was not possible for the researcher to explore the areas in a greater depth and comprehensive manner, the conclusions are restricted to conditions prevailing in the study area and any attempt at generalization must be done with care. However accomplishment of the objectives to the maximum extent possible has been earnestly tried for.

Theoretical Orientation

2. THEORETICAL ORIENTATION

Concepts relating to any systematic study must be defined clearly before presenting the results. A comprehensive review of literature is important as it helps in better understanding and meaningful conceptualization of the study. This chapter reviews the available information from similar or related studies.

Very few studies from social analysis only have been attempted on cassava and therefore availability of literature pertinent to cassava was inadequate. However, sincere efforts have been made to review the related literature which were found meaningful and having direct or indirect bearing on the study. The literature related to other horticultural and tuber crops were considered on priority and furnished under the following subheads.

2.1 Importance of cassava

2.2 Profile characteristics of cassava cultivators

2.3 Production system typology

2.4 Technology utilization pattern

2.5 Technology gap

2.6 Constraints in cassava cultivation

2.7 Reason for decline in area under cassava

2.8 Training needs of farmers in cassava production and processing

2.1 IMPORTANCE OF CASSAVA

Food and Agriculture Organization (FAO, 1986) reported that tropical tuber crops like cassava are the third most important food crops

after cereals and grain legumes. They form an important subsidiary or staple food of one fifth of world's population.

Cassava finds an important place in socio-economic status of small and marginal farmers of southern and north-eastern regions (Anantharaman *et al.*, 1989). It may be noted that cassava is one of the very few crops where the national average yield is double than that of world average of 10 t ha^{-1}.

Anantharaman *et al.* (1993) reported that in India, cultivation of cassava is mostly concentrated in the southern states of Kerala, Tamil Nadu and Andhra Pradesh together they contribute 90 per cent of the area and production of cassava in the country. However contrasting features exist between the states in terms of production and marketing system. Cassava is used as a raw material for production of starch and Sago in Tamil Nadu and Andhra Pradesh. Majority of the cassava factories were found operating much below their full capacity utilization mainly because of lack of adequate tuber supply, continued use of age-old machines and lack of adequate industrial policies. Cassava enjoyed prime importance in the dietary habits of weaker sections and with the advent of production boom in the food grains coupled with efficient distribution system, drifted dependence from tuber crops to food grains.

In Kerala cassava is almost cultivated under rainfed condition and marketed mostly for human consumption, whereas in Tamil Nadu, it is under irrigated condition and marketed as raw materials to sago and starch units (Nayar *et al.*, 1995; Ghosh, 1996). As a corollary, the productivity also display a striking difference between the two states with Kerala having an average yield of 19 t ha^{-1} and Tamil Nadu 32 t ha^{-1}.

During early sixties, India (mostly Kerala) was exporting cassava mainly to European countries. However, India went out of export trade after 1964 mainly due to domestic food situation, which forced the State

Government of Kerala to conserve all supplementary food within the state (Anantharaman and Nambiar, 1997).

Edison (2000) reported that a wide variety of instant "ready to eat food" products *viz.*, cassava and porridge, sweet potato energy drink, sweet potato jam, pickle, sauce, etc. can be prepared from cassava and sweet potato which can enhance market appeal for tuber crop products. He also reported that apart from the food and feed utilization, cassava has got a vast number of industrial applications *viz.*, alcohol from cassava, gums, dextrins and cold water soluble starch. Of late, the starch based biodegradable plastics developed from cassava have received wide attention due to the ability to reduce pollution load, besides being ecofriendly.

The World Health Organization (WHO, 2001) estimation shows that in many of the under developed and developed countries several nutritional disorders are prevalent. Protein, vitamin A, vitamin C and calcium deficiencies would be easily alleviated by consuming root and tuber crops like cassava and sweet potato. There is a specified RDA (recommended dietary allowance) which is possibly met by just 500 grams of cassava per head per day. Since cassava is affordable to the poor nutritional security can be easily achieved.

Edison (2002) revealed that cassava can grow well in a wide range of soil types and require relatively less care in terms of labour and other inputs. They are comparatively free from severe pests and diseases and crop protection measures and especially free from chemical fertilizers.

2.2 PROFILE CHARACTERISTICS OF CASSAVA CULTIVATORS

2.2.1 Age

Ramanathan *et al.* (1985) reported that major portion of cassava cultivators (77.78 %) were old and 22.22 per cent were young in age.

Anantharaman (1993) reported that age alone cannot influence adoption and it has to go with knowledge and mass media exposure.

Olowu *et al.* (1988) observed that most of the ohaji cassava cultivators (79.50 %) were around 40 years old.

Saravanan (1992) reported that majority of the cassava cultivators (69 %) were in the category of middle aged group.

Ramesh (1994) recorded that majority of the cassava cultivators (54.39 %) were in the age group of 40-49 years.

Subhashini (1996) revealed that 37.50 per cent of the cassava cultivators were old, followed by young (35.83 %) and middle aged (26.67 %).

Sakthivel (2000) observed that 44.17 per cent of the cassava cultivars fell under middle aged group.

2.2.2 Educational Status

Ramanathan *et al.* (1985) reported that majority of the cassava cultivators had education upto middle school level and 25.33 per cent were illiterates, 14.79 per cent had secondary level of education, followed by functionally literate (11.58 %), collegiate education (11.09 %) and primary education (8.88 %).

Subhashini (1996) stated that 19.17 per cent of the cassava cultivators had primary education followed by secondary (18.33 %0 and middle level (17.50 %). Only 11.67 per cent of the respondents were illiterate and 10.0 per cent of the respondents were in the three categories *viz.*, collegiate (8.33 %), can read only (8.33 %) and higher education (6.67 %).

Bindu (1997) reported that 50.00 per cent of the cassava cultivators had education upto high school level, followed by 45.00 per cent of the respondents who had primary school level education, while 3.33 per cent

of the respondents were educational upto pre-degree level only 1.67 per cent were illiterate.

Sakthivel (2000) revealed that little more than one-fourth of the respondents (26.67 %) had education upto secondary level, followed by middle education (18.33 %) and primary education (16.67 %). Only 8.33 per cent were educated upto collegiate. Among those who had no formal education 25.00 per cent were illiterates and 5.00 per cent were functionally illiterates.

2.2.3 Experience in Cassava Cultivation

Kumar (1992) reported that 40 per cent of the farmers had six to ten years experience in cassava cultivation.

Menon (1995) stated that majority (54.50 %) of the cassava growers had medium level of experience followed by low (20.80 %) and high levels (24.70 %) of experience.

Ravisankar and Katteppa (1999) observed that (91.66 %) of cassava growers possessed more than 10 years of experience followed by (8.35 %) of farmers with five to ten years experience.

Arunkumar (2002) reported that majority (68.75 %) of the cassava growers belonged to medium group with respect to experience in cassava farming.

2.2.4 Area under Cassava Cultivation

Malik *et al.* (1993) found that about 38 per cent of the farmers were cultivating cassava in the area of more than 30 cents.

Ramesh (1994) revealed that more than two third of the farmers belonged low category with respect to area under cassava cultivation.

Sundarambal (1994) reported that majority (78.00 %) of the farmers had medium level of area under cassava cultivation.

Subhasini (1996) reported that 38.63 per cent of the respondents' area under cassava cultivation was upto 0.27 areas.

Surendran (2000) reported that large farm size resulted in more returns from farming which was conducive for higher group participation.

2.2.5 Scientific Orientation

Kamarudeen (1981) found significant positive relationship between scientific orientation and attitude of farmers towards the demonstrated agricultural practices.

Bindu (1997) reported that 38.0 per cent, 32.00 per cent and 30.00 per cent of the cassava cultivators belonged to the high, low and medium scientific orientation, closely followed by medium level (34.17 %) and high level of scientific orientation (30.83 %).

Sakthivel (2000) revealed that 35 per cent of the respondent had low level of scientific orientation, closely followed by medium level (34.17 %) and high level of scientific orientation (30.83 %).

2.2.6 Contact with Extension Agency

Ravi (1979) found that majority of the cassava cultivators (70.83 %) had medium degree of contact with extension agency, followed by one fifth (19.17 %) of the respondents with high degree of contact, whereas one tenth (10.00 %) had low degree of contact with extension agency. It is also found out that as far as contact with extension agencies was concerned, nearly two third of the cassava cultivators had low contact.

Gowda *et al.* (1981) stated that majority of the potato growing farmers (69.40 %) had high extension agency contact.

Ramanathan *et al.* (1985) reported that farmers participating in various extension programmes related to cassava conducted by different extension agencies generally had high knowledge level.

Olowu *et al.* (1988) stated that 90.00 per cent of the cassava cultivators had frequent contact with extension agents.

Saravanan (1992) reported that majority of the cassava cultivators (52.50 %) medium level of extension agency contact, followed by low (24.1 %) and high (23.33 %) levels.

Subashini (1996) revealed that majority of the cassava cultivators (84.17 %) had medium level of contact with extension agency followed by low level of contact (10.00 %). Only 5.83 per cent of the respondents had high level of extension agency contact.

Sakthivel (2000) observed that less than 50 per cent (47.50 %) of the cassava farmers had high level of extension contact.

Arunkumar (2002) reported that 48.50 per cent of the cassava farmers had high level of extension orientation.

2.2.7 Economic Motivation

Krishnakumar (1996) observed that about two third of the respondents (66.00 %) had medium level of economic motivation followed by low and high level of economic motivation to the extent of 19 and 15 per cent respectively.

Bindu (1997) revealed that 46.66 per cent of the cassava cultivators belonged to the high economic motivation category, while 26.67 per cent each belonged to the medium and low economic motivation categories.

Sivaprasad (1997) found that economic motivation was an important character that persuades people to adopt improved practices that are proven worthy.

Sriram (1997) observed that majority of the farmers (58.34 %) had medium level of economic motivation followed by high and low levels.

Sakthivel (2000) reported that 46.66 per cent of the cassava cultivators had high level of economic motivation followed by medium level (26.67 %) and low level (26.67 %).

Srinivas and Anantharaman (2000) reported the total cost of Rs. 3,460.00 per acre was incurred as expenditure for cultivating cassava. Labour component accounted for 62.43 per cent (Rs. 2160.00) of the total cost of cultivation, while material cost accounted for 37.57 per cent (Rs. 1300.00).

2.2.8 Self-confidence

Khara (1976) opined that confidence would play an important role in the success of a creator or innovator.

Ravi (1979) found positive and significant relationship between self-confidence and adoption of cassava technology.

Joseph (1983), Nizamudeen (1986), Varma (1996) and Sangeetha (1997) reported as good majority of respondents belonged to high group with respect to self-confidence.

Saravanan (1992) revealed that more than 75 per cent of cassava farmers exhibited medium level of self-confidence.

Bindu (1997) revealed that more than 68 per cent of cassava farmers exhibited medium level of self-confidence.

Pradeepkumar (1993) reported that majority of the beneficiaries had more self-confidence.

Meera (2001) observed that maximum (758.83 %) number of respondents were in the high category with respect to self-confidence.

2.2.9 Innovativeness

Ravi (1979) revealed that majority of the cassava cultivators (77.50 %) had high level of innovativeness, whereas 14.17 per cent of them had medium level of innovativeness. Only 8.33 per cent of the respondents had low level of innovativeness.

Ravichandran (1980) reported that innovativeness was negatively and non-significantly associated with adoption of registered sugarcane growers.

Sajeevachandran (1989) observed that there was significant and positive relationship between education and innovativeness.

Menon (1995) observed that innovativeness had contributed to the changing farming conditions and continues to raise the performance level of farmers. Thus a modern farmer who is innovative is willing to change his believes, attitudes and ways of acting in response to new challenges and developments.

Sakthivel (2000) found that equal proportion (39.17 %) of the cassava cultivators had low and medium level of innovativeness, followed by 21.66 per cent of them with high level of innovativeness.

2.2.11 Knowledge

Bhaskaran and Praveena (1982) reported that non adoption of control measures against mosaic disease. Inspite of knowledge acquisition owing to the programme, only 77 per cent of the farmers, expressed the belief that there is no reduction in yield. This may be possibly due to the fact that yield reduction could not be felt by the farmers by visual judgment.

Ramanathan and Anantharaman (1982) found that the respondents had significantly higher knowledge not only in overall cultivation practices of cassava but also in all aspects of cultivation like seeds and sowing, manures and manuring, interculturing and plant protection.

Ramanathan *et al.* (1985) reported that more than three fourth of cassava cultivators possessed low knowledge not only in overall cultivation but also in all the individual aspects such as manuring, after cultivation and groundnut intercropping, except seeds and sowing. He also reported that young age farmers had low knowledge about improved practices of cassava cultivation.

Ramanathan *et al.* (1991) reported that the level of knowledge on improved cassava cultivation was very low.

Saravanan (1992) revealed that educational status, annual income, social participation, extension agency contact, media participation, innovativeness, scientific orientation, risk orientation and economic motivation had positive and significant association with knowledge level of cassava cultivators.

Annamalai and Somasundram (1994) reported that mass media exposure showed positive and significant relationship with the knowledge on soil conservation practices. Further they reported that farming experience showed negative and significant relationship with knowledge.

Subhasini (1996) found that a vast majority of the cassava cultivators (96.67 %) had knowledge on recommended varieties. Nearly three-fourth of the respondents had knowledge on irrigation (72.22 %) and spacing (71.86 %). More than half of the respondents had knowledge on manuring (61.43 %) and setts treatment with fungicides (56.25 %). Most of the respondents possessed knowledge on selection of setts (86.67 %) and setts treatment with biofertilizers (45.00 %). About one-third (30.45 %) of the respondents had low knowledge on micronutrient application practices. The overall knowledge level on recommended technology practices was medium among the respondents

Bindu (1997) reported that 98.66 per cent of the cassava cultivators had knowledge regarding selection of planting material, ridge or mound method of planting setts (vertical or horizontal), while none of the respondents were aware of the chemical to be used for treatment of setts. She also reported that more than 90.00 per cent of the respondents were aware of the practices like length of setts (96.66 %), planting season (96.66 %), recommended varieties and their duration (95.00 %) and depth of planting (93.33 %), while the practices like basal application of fertilizers, varieties resistant to bacterial blight and mosaic disease.

Further she observed that quantity of manures per acre (88.33 %), inter crops recommended (81.66 %), average yield from recommended varieties (78.33 %) recommended fertilizer dose (76.66 %), number of shallow digging after planting (71.66 %), top dressing of fertilizer (70.00 %), plant population per acre (66.66 %), spacing (66.66 %) and suitable soil types (60.00 %).

Ravishankar and Katteppa (1999) reported that 43.00 per cent of the respondents had maximum level of knowledge on improved cassava practices, followed by low (34.00 %) and high level of knowledge (23.00 %).

Sakthivel (2000) reported that out of fifteen characteristics selected for the study, innovativeness and progressiveness had shown a positive significant relationship with knowledge level of the respondents.

2.2.12 Leadership Quality

Pavry (1972) reported that leadership play an important role in developing political consciousness and mobilizing people and community they present.

According to Lierman (1991) leadership is in Individual's willingness to accept and fulfil a given responsibility in easing others the want to accomplish the task at hand.

Desai (1995) found that leadership is an important ingredient in the level and form of community participation.

Ban (1997) reported that a participatory approach requires changes in the leadership styles and culture of extension agency.

Noor (1998) refers leadership as the process of influencing people towards activity derived in the most desired way.

2.2.13 Market Orientation

Ravi (1979) reported that majority of the tapioca farmers (69.17 %) used palm leaves, while 20.83 per cent used gunny bags and 10 per cent

used coconut leaves for packing the tubers. Sixty per cent of them carried by head load. One-fifth of them used bullock carts and cycle for transport. Majority (59.17 %) of the farmers sold tubers in nearby town and 40.83 per cent sold locally. Private merchants played a major role in marketing. Only a meagre percentage of 2.50 per cent and 1.67 per cent of them sold products to wholesale merchants and commission agents respectively. Cent per cent sold on weight basis. Almost all the farmers (98.33 %) sold it for ready cash. Credit sale of specified merchants was followed by 1.67 per cent of farmers. Majority (63.33 %) of the farmers felt that marketing facilities are sufficient.

Sakthivel (1979) found that there was a non-significant association between market perception and extent of adoption practices.

Manoharan (1980) concluded that majority of the followers of market regulation were middle aged, had medium level of farming experience, economic motivation, higher level of risk orientation market perception.

Somu (1982) revealed that adopter farmers to market regulation were found to be significantly different from non-adopter farmers with regard to their attitude towards regulated market.

Malik *et al.* (1993) found that 92.00 per cent of marketable surplus was sold through wholesalers and commission agents by the farmers. There were 93.53 per cent farmers who sold their produce outside the village and only 6.47 per cent sold their produce in the village market.

Bindu (1997) observed that out of 15 characteristics studied socio-economic status, market perception, farm size, information seeking behaviour social participation, education, risk orientation, marketable surplus, storage facility, extension agency contact and market decision were found to be positively and significantly associated with extent of adoption of improved cassava technology.

2.2.14 Mass Media Exposure

Ravi (1979) revealed that majority (59.17 %) of the cassava cultivators had medium level of mass media exposure. Low and high level of mass media exposure was found with 24.17 per cent and 16.66 per cent of the respondents respectively.

Sophia (1991) in the study on adoption and associated factors among dry land farmers stated that nearly three fifth (62.22 %) of the dry land farmers possessed medium level of mass media exposure.

Saravanan (1992) found that the respondents had in the order of medium (58.34 %), low (26.66 %) and high (15.00 %) levels of media participation.

Chandran (1993) reported that majority of the cassava farmers, had medium level of mass media exposure.

Subhashini (1996) found that 38.34 per cent of the cassava cultivators had medium level of mass media exposure, whereas a similar proportion of respondents (30.83 % each) had high and low exposure to mass media.

2.2.15 Social Participation

Hussain (1992) reported that group management approach had brought in favourable changes in the character of social participation of rice farmers.

Arunkumar (2002) reported that majority of the cassava cultivators had medium level (59.20 %) of social participation and 24.50 per cent had low level only (12.30 %) had high level of social participation.

Sindhu (2002) reported that the old farmers are likely to loose interest in active participation within and outside the social system.

2.3 PRODUCTION SYSTEM TYPOLOGY

A system is an assemblage of elements in a system; within the boundary elements are strongly linked and across the boundary loosely linked. Production system is an ecological system partially modified by man to produce food, fibre or other agricultural products. A production system could be under stood only when various elements are studied in terms of space, time, flow and decisions.

Production system typology refers to the categorization of cassava cultivation in terms of types of land (upland, lowland, homestead) type of cropping component (monocropping, intercropping and mixed cropping) and type of cropping objectives (commercial, semi-commercial and subsistence).

Prain and Fano (1991) identified the production system based on wide range of criteria including climate, topography, cropping purpose collected based on Participatory Research Appraisal techniques/secondary data. The typology could be as,

Sub-humid, arid, subtropical low lands, tropical highlands, humid tropical lowlands in the case of Argentina.

Prain and Fano (1991) identified production system as fallow system, rice based, mixed crop and home garden production system.

Ghosh (1991) classified production system according to Indian agro-climatic zones could be brought out under middle Gangetic plains, upper Gangetic plains, Eastern plateau and hill regions, East coast plains and hill regions, East Himalayan region and West coast plain and Ghat region.

Rhoades (1991) identified cassava production system of Asia Pacific had four major kinds a) extensive, low input, low labour production association with shifting cultivation, b) intensive, low input high labour systems association with village based garden system c) small scale

household gardening or specialised niche pod (intercropped or along hedgerows etc.) based on household labour and d) intensive, high input, mechanized, commercial production aimed at agro industries.

Ganga and Posa (1996) reported rainfed Swidden, irrigated terraces and home garden production system in highlands of Northern Philippines.

Anantharaman and Nambiar (1997) classified production system under Kerala condition as upland (rainfed, low land (irrigated)) and home garden system.

2.4 TECHNOLOGY UTILIZATION PATTERN

Ravi (1979) reported that almost equal percentage of tapioca growers had medium and high level of extent of utilization (40.00 % and 39.17 % respectively) and only one fifth of the respondents (20.83 %) had low level of utilization.

Sivaramakrishnan (1981) found that the extent of utilization recommended practices was least for cassava as compared to rubber, coconut and rice in Kerala state.

Ramanathan and Anantharaman (1982) found that practices such as sett, length, planting method and number of setts per hill were uniformly well utilised by majority of cassava farmers.

Ramanathan *et al.* (1985) reported that half of the cassava farmers (50.66 %) had medium utilization level, followed by low (46.67 %). Only a meagre percentage of the respondents (3.67 %) had high utilization level.

Anantharaman *et al.* (1986) reported that half of the cassava farmers (50.66 %) had medium utilization level, followed by low level of farmers (46.67 %). Only a meagre percent of the respondents (2.67 %) had high utilization level.

Olowu *et al.* (1988) found that 16.70 per cent of the cassava farmers utilized atleast one of the improved varieties.

Ramanathan and Anantharaman (1991) in their study revealed that large percentage of farmers were found to utilize high yielding varieties (57.00 %), spacing (49.00 %) leaving two shoots (30.00 %) and applying fertilizers (67.00 %). They also reported as significant improvement in utilization of cassava technologies, due to implementation of various development programmes.

Sundarambal (1994) reported that majority of the farmers had medium level of utilization (77.14 %) followed by high (15.24 %) and low (7.62 %) utilization levels.

Kishorekumar (1995) stated that the utilization for rodent control practice in cassava cultivation was moderate (27.14 %), the utilization level for harvesting was high (74.28 %), whereas the utilization level for manuring was low (5.71 %).

Bindu (1997) found that majority of the cassava cultivators had utilized practices like recommended variety M-4, planting season, method of planting, depth of planting and plant protection measures against non-insect pest like rat. None of the respondents followed the practice of treatment of setts before planting. Majority of the respondents did not follow the recommended plant population, fertilizer application and plant protection measures against insect pests and diseases.

Majority of the cassava farmers (87 %) were found to be low adopters of improved production technology. Except for the practice of stake length, a majority of the farmers continued with the traditional methods in other practices (Anantharaman and Nambiar, 1997).

Anantharaman *et al.* (1989) reported that large percentage of farmers were found to be adopting high yielding varieties (57 %) spacing (45 %) leaving two shoots (30 %) and applying fertilizer (67 %). The proportion

of full adopters to partial adopters of various practices by programme beneficiaries and the spread of the introduced technologies to the non-beneficiaries indicate clearly the vertical and horizontal diffusion of improved cassava technologies transferred under the LLP amongst the farming community in the participating villages.

2.5 TECHNOLOGY GAP

Anantharaman *et al.* (1993) reported that technology gap was found to be very low (10 %) in adopting certain non-monitory practices like recommended spacing, leaving two healthy opposite shoots showed increase due to exposure to the programme.

2.6 CONSTRAINTS IN CASSAVA CULTIVATION

Ravi (1979) observed that lack of industrial facilities was the major problem faced by 89.17 per cent of the tapioca farmers.

Ramanathan and Anantharaman (1982) reported that lack of knowledge and non-availability of planting materials were the common reasons for non-adoption of improved cassava cultivation practices.

Kishorekumar (1995) reported non-availability of quality high yielding varieties and post-harvest problems with respect to storage of fresh tubers were the main constraints faced by cassava farmers.

Menon (1995) reported that lack of suitable varieties exhibiting resistance to nematode and at the same time having good quality was the major technical constraint expressed by the small and large farmers, followed by pests and diseases problem with a mean score of 50.42 and water problem in the first season with a mean score of 46.00. Progressive farmers however, indicated water problem in the first season as the major constraint with a score of 58.88 followed by pest and disease and lack of suitable varieties

Subhashini (1996) reported that lack of tapioca grower's societies (99.17 %) wide fluctuations in price of tapioca tubers (98.33 %), exploitation by middlemen by charging heavy rate of commissions, brokerage etc. (97.50 %), lack of technical guidance (89.17 %) and non-availability of fertilizers at required time (60.00 %) were the major constraints expressed by the cassava cultivation.

Ravishankar and Katteppa (1999) reported that the major problem orientated constraint as expressed by majority of the farmers (94.16 %) was the lack of technical guidance and 90.83 per cent of the respondents expressed high cost of storage as the major storage constraint. They also added that 93.37 per cent of the respondents expressed high cost of transportation as the major constraint in marketing.

Sakthivel (2000) reported that labour scarcity, irrigation constraints, non-availability of inputs in time and in required quantity were mentioned as the major constraints in the cassava cultivation.

2.7 REASON FOR DECLINE IN AREA UNDER CASSAVA

Spencer and Kainaneh (1997) identified that the declining soil fertility, insufficient and poor planting material, the lack of well adopted varieties and pests and diseases as the major reason for decline in cassava area of Sub-Saharan Africa.

Scott *et al.* (2000) observed that the lengthy growing season of cassava (10 to 12 months) is a comparative disadvantage in relation to other crop staples, such as beans, rice and maize.

Henry and Iglesias (1993) identified that the low multiplication rate of cassava is an another declining factor of area under cassava. They says cassava's vegetative reproduction system depends on segments (stakes) cut from the stem of mature plants. Each plant can produce eight to twelve of these sakes while one hectare of cassava generates planting material for just 10 ha in one year, both maize and rice can generate

planting material for 1600 ha, or a multiplication rate 160 times higher than cassava.

El-Sharkawy (1993) reported that the majority of the cassava throughout the world is grown under adverse climatological and soil conditions, and on relatively small, poor farmers in marginal areas are the other declining factors of cassava cultivation.

2.8 TRAINING NEEDS OF FARMERS IN CASSAVA PRODUCTION AND PROCESSING

Sharma and Singh (1966) measured the training needs of Animal Husbandry Extension Officers in Punjab by using a Training Need Quotient (TNQ) specially developed for the study.

$$TNQ = \frac{\Sigma\, OSij}{\Sigma\, MSij} \times 100$$

where, OSij – Sum of observed scores of j^{th} individual

MSij – Maximum scores attributable to the item rated by the j^{th} individual.

Sharma (1970) stated that the knowledge and skills of farmers needed to be increased in subjects like plant protection, manures and fertilizers and improved seeds.

Anantharaman (1977) inferred that both the small and marginal farmers commonly needed training in characteristics of good seeds, pre-treatment of seeds, calculation of unit cost of fertilizers, application of fertilizers according to soil condition, optimum doses of fertilizers, schedule of different plant protection chemicals, reclamation of acidity and alkalinity of soils, methods of soil conservation, marketing of produce through formal institutions, nutrient value of different vegetables and

fruits crop rotation, maintenance of milch animals and calf rearing in that ordered sequence.

Annamalai and Anantharaman (1978) reported that 'training need is the difference between what is and what ought to be'. It is really the discrepancy between the actual estimated requirements and the estimated or measured attributes of the people incorporated judiciously in the training objectives.

Sivaprasad (1997) reported that majority (78.00 %) of the respondents had high level of training.

Parvathy (2000) observed that majority of rural women (66.30 %) and women office bearers (70.00 %) had medium level of training.

Lakshmi (2000) revealed that more than half of the respondents did not attend any training programme related to watershed management.

Meera (2001) reported that maximum (86.66 %) number of respondents had low level training.

Parthasarathi and Govind (2002) reported that the knowledge level of trained farmers was much higher on biological and physical methods of pests control identification of pests and predators and on economic threshold levels.

Methodology

3. METHODOLOGY

This chapter elucidates the research methods and procedures followed in the study. The methodology adopted is presented under the following subheads.

3.1 Research design

3.2 Locale of research

3.3 Selection of respondents

3.4 Selection, operationalisation and measurement of variables

3.5 Methods used for data collection

3.6 Statistical tools used

3.1 RESEARCH DESIGN

The study was conducted following an ex-post facto research design. Ex-post facto research is a systematic empirical enquiry in which the scientists do not have direct control over the independent variables because their manifestations have already occurred or because they are inherently not manipulatable (Kerlinger, 1973).

3.2 LOCALE OF RESEARCH

Thiruvananthapuram district was selected for the study due to the following reasons (Fig. 1a).

Thiruvananthapuram district has an area of 0.27 lakh ha under cassava with a production of 4.68 lakh tonnes during 2002-2003. it has the largest production and productivity of cassava in Kerala.

As against the world average of 10 tonnes per ha and national average of 20 tonnes per hectare, Thiruvananthapuram district has

1.	Panavoor	4.	Kilimanoor
2.	Karakulam	5.	Kazhakuttom
3.	Nagaroor	6.	Pothencode

Fig. 1a. Locale of the study

recorded 20.42 tonnes because of excellent soil and climatic conditions suitable for cassava cultivation.

3.2.1 Selection of Blocks

In Thiruvananthapuram district, there are 12 block panchayats. From these block panchayats three block panchayats with highest area under cassava were selected from three types of production systems according to the topography of hilly, upland and coastal area. Two Grama panchayats from each selected block panchayat having highest area under cassava were selected as the study area.

3.3 SELECTION OF RESPONDENTS

The list of cassava farmers from each selected panchayat was prepared and 25 farmers from each panchayat were randomly selected as the respondents. Thus the total number of farmer respondents was 150. In addition to these, 50 respondents comprising scientists working on cassava, extension functionaries, cassava sellers and consumers were selected for identifying reason for decline in area under cassava.

Panchayat wise distribution of respondents

Sl. No.	Block / Region	Grama panchayat	Number of respondents
1	Nedumangad (Hilly)	Panavoor	25
		Karakulam	25
2	Kilimanoor (Midland)	Nagaroor	25
		Kilimanoor	25
3	Kazhakuttom (Coastal)	Kazhakuttom	25
		Pothencode	25
	Total		150

3.4 SELECTION, OPERATIONALISATION AND MEASUREMENT OF VARIABLES

3.4.1 Independent Variables

The process of variable selection, their operationalisation and empirical measures are discussed here.

By reviewing various literature and discussion with the experts, 14 independent variables were selected (Appendix I) and technology gap was selected as the dependent variable.

A summary of the selected independent and dependent variables and their measurement procedures are presented below.

3.4.1.1 Age

Age has been operationalised as the number of completed years of the respondents at the time of interview and the chronological age was taken as the measure. A score of one was given for every completed year. The respondents were categorized into three groups as classified by Kanimozhi (2001).

Sl. No.	Category	Age (in years)
1	Young	Upto 35
2	Middle	36-50
3	Old	Above 50

3.4.1.2 Education

It refers to the educational status of the respondents at the time of study. The sub items were illiterate, primary education, secondary education and college education. The scoring procedure developed by Mansingh (1993) was followed.

Sl. No.	Category	Score
1	Illiterate	0
2	Primary education	1
3	Secondary education	2
4	College education	3

3.4.1.3 Experience in Cassava Cultivation (years)

Refers to the total number of years a respondent has been engaged in cassava cultivation. The method adopted by Sreedaya (2000) was used in this study with slight modification. The scoring procedure was

Sl. No.	Experience
1	Upto 5 years
2	6 to 10 years
3	11 to 25 years
4	Above 25 years

3.4.1.4 Area under Cassava Cultivation

It was measured as the extent of area under cassava cultivation in acres. The following scoring pattern was employed in this case as done by Sreedaya (2000) with slight modification.

Sl. No.	Size of holding (in acres)	Score
1	< 1 acre	1
2	1-2 acre	2
3	2-3 acre	3
4	3-4 acre	4
5	>4 acre	5

3.4.1.5 Scientific Orientation

According to Supe (1969) it is the degree to which a farmer is oriented to the use of scientific methods in decision making and in farming. Scientific orientation was measured with the help of a scale developed by Supe (1969). The scale consists of six statements of which five are positive and one is negative as given in the interview schedule. The responses for each statement were rated in a five point continuum ranging from strongly agree to strongly disagree.

The scoring was done as follows:

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Score for positive items	4	3	2	1	0
Score for negative items	0	1	2	3	4

After scoring for each statement mentioned in the interview schedule, the scores were summed up to obtain the final scientific orientation score of each respondent. The score ranges from 0 to 24.

3.4.1.6 Contact with Extension Agency

It was operationalised as the degree to which farmers used to maintain contact with extension agencies. This variable was measured in terms of frequency and whom the farmers approach for seeking information.

To quantify the variable an arbitrary scoring procedure was developed as given below.

Sl. No.	Category of personnel	Frequency of contact		
		Regular (2)	Occasionally (1)	Never (0)
1	Agricultural Assistants			
2	Agricultural Officers			
3	Agricultural Scientists			
4	Extension functionaries of NGO			
5	Others			

The possible score ranges from 0 to 10.

3.4.1.7 Economic Motivation

Economic motivation refers to the extent to which a person is oriented towards profit maximization and relative value he places on monetary gains.

It was measured using the scale developed by Supe (1969) with slight modification. The scale consists of six statement in which the responses were collected on a five point continuum *viz.*, strongly agree, agree, undecided, disagree and strongly disagree with weightage of 4, 3, 2, 1 and 0 for positive statements and 0, 1, 2, 3 and 4 in the case of negative statements.

The scores obtained on each statement were summed up to arrive at individual score on economic motivation. Thus possible score ranges from 0 to 24. The scoring procedure was done as follows.

Category	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Score for positive items	4	3	2	1	0
Score for negative items	0	1	2	3	4

3.4.1.8 Self Confidence

Self confidence refers to the degree of faith a person has in his own powers, ability and resourcefulness to perform an activity.

The variable was measured by using the scale designed by Pandyaraj (1978) were the scale consists of eight items in which the responses were collected on a five point continuum *viz.*, strongly agree, agree, undecided, disagree and strongly disagree with weightage of 4, 3, 2, 1 and 0 for positive statement and 0, 1, 2, 3 and 4 for negative statement. The scoring procedure was done as follows.

Category	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Score for positive items	4	3	2	1	0
Score for negative items	0	1	2	3	4

The self confidence score for each individual was calculated by summing up the score on individual statements. The possible range of score is 0 to 32.

3.4.1.9 Innovativeness

Refers to the degree to which the respondents was relatively earlier in adopting new ideas. The procedure followed by Sreedaya (2000) was used to measure innovativeness with slight modification. In this procedure a question was asked when the farmers would like to adopt an improved practice. The response was scored as follows:

Sl. No.	Response	Score
1	As soon as it is brought to my knowledge	3
2	After I had seen other farmers tried successfully in the farm	2
3	I prefer to wait and take my own time	1
4	I am not interested in adopting improved practices	0

3.4.1.10 Leadership

Leadership quality is operationally defined as the ability of the farmers to influence others to co-operate in the attainment of a goal. The leadership quality of farmers was measured by using the scale developed by Surendran (2000) with slight modification. The schedule consists of six statements. The responses were obtained in a three point continuum *viz.*, always, sometimes and never. The scoring was 2, 1 and 0. The scoring procedure was as follows.

Sl. No.	Statements	Always (2)	Sometimes (1)	Never (0)
1	Do you think you can change the attitude of others?			
2	Do you guide and influence the behaviour of others in taking decisions?			
3	Do you lead meetings and discussions?			
4	Do you feel others are convinced by you?			
5	Are you available to others at any time to extend necessary help to them?			
6	Do you identify the social problems and take these with others for resolving?			

The possible score ranges from 0 to 12.

3.4.1.11 Knowledge

Knowledge is defined as those behaviour and test situation which emphasized the remembering either by recognition or recall of ideals and material on some phenomena has a significant influence on adoption (Sharma *et al.*, 1970).

Knowledge being a qualitative character needs to be quantified for assessing the knowledge level of farmers. The knowledge test developed by Anantharaman and Ramanathan (1991) was used in this study.

The selected 12 questions were framed in the objective type. The respondents were requested to tick mark the correct answer for each question. Correct and incorrect answers were given a score of 1 and 0 respectively. The total knowledge score of each respondent was calculated by total number of items correctly answered by him.

3.4.1.12 Market Orientation

Market orientation refers to the capacity of the respondents to identify the market trend to sell the produce for great return (Ponnuswamy, 1993).

An arbitrary scoring procedure was developed for studying the market orientation. The method consisted of scoring the responses obtained to questions presented to the respondents to elicit the preparation of the market for the produce. The questions and the scoring procedure adopted were as follows.

1. Do you think the selection of cassava varieties that suit consumer demand is necessary for getting good price? Yes = 1, No. = 0
2. Is it possible for a farmer to get reasonable good price if he cultivates cassava compared to other crop? Yes = 1, No = 0.
3. How do you feel about the salability of cassava? Easy = 2, Difficult = 1, Very difficult = 0.

4. Do you adopt a marketing strategy in which the buyers have been appropriately selected from categories such as intermediaries, sellers or the ultimate consumers in such a way as to get maximum price? Always = 2, Sometimes = 1, Never = 0.

The maximum possible score for the above is ranging from 0 to 6.

3.4.1.13 Mass Media Exposure

It refers to the degree to which an individual has used mass media information sources. The procedure used by Pradeepkumar (1993) was used to quantify this variable with slight modification. The scoring was done as given below.

Sl. No.	Mass media	Regularly (2)	Occasionally (1)	Never (0)
1	Radio			
2	Newspaper			
3	Television			
4	Magazine			
5	Internet			
6	Books			
7	Other literature on agriculture			
8	Others			

Possible score ranges from 16 to 0.

3.4.1.14 Social Participation

Social participation was operationalised as the degree of involvement of respondents in formal organizations as member and office bearer.

An arbitrary scoring procedure was developed for the study purpose as given below.

Sl. No.	Organization	Nature of participation		Frequency of participation		
		Office bearer (2)	Member (1)	Regular (2)	Sometimes (1)	Never (0)
1	Karshika Vikasana Samithies / Other Vikasana Samithies of Krishibhavan					
2	Co-operative society					
3	Farmers / Youth club					
4	Farmers organisation					
5	Trade organisation					
6	Political party					
7	Others (specify)					

The scores obtained by a respondent on the above two dimensions (nature of participation and frequency of participation) were summed up across each item for all the organisations which gave his social participation score. The possible score ranges from 0 to 40.

3.4.2 Production System Typology

Based on the operationalisation of production system typology, a separate schedule was prepared to categorise the respondents under various production systems as indicated below.

Sl. No.	Particulars	Total area (in cents)	Leased in (in cents)	Owned (in cents)	Production (t)	Mono crop (in cents)	Inter crop (in cents)	Mixed crop (in cents)	Home stead (in cents)
1	Lowland								
2	Upland								
	Total								

Further to categorize the farmers based on farming objectives the procedure followed was

(1) Commercial farmer : One who sells more than 50 per cent of his produce. He is included in the category of commercial farmer.

(2) Semi-commercial farmer: One who sells his produce between 20 to 50 per cent, is included in the category of semi-commercial farmer.

(3) Subsistence farmer: One who sells less than 20 per cent of his produce, is included as subsistence farmer.

3.4.3 Technology Utilization Pattern

It is the nature and extent of use of different cassava cultivation practices.

In order to identify the utilization pattern of various recommended technologies followed by cassava farmers, a list of practices was prepared in consultation with experts and based on review of literature (Appendix II). It included 12 items *viz.*, selection of varieties, selection of stems, sett preparation, land preparation and planting, depth of planting, spacing, intercropping, application of FYM, cassava mosaic management, application of inorganic fertilizers, weeding and earthing up, time of cassava harvesting and storage of planting material.

The respondents were asked how they have adopted the practices under 12 items. Information on the nature and extent of use of practices were collected and presented in a descriptive manner, also using scoring procedures, frequency percentages etc.

3.4.4 Technology Gap

Technology gap is operationally defined as the gap for difference between the potential for the technology utilisation as envisaged in the package of practice and actual utilisation. Technology gap in adoption of scientific technologies was considered as the dependent variable for this study. For measuring this an adoption index was prepared. All the

important technological components of cassava production were included. The technological gap was calculated by using the following formula developed by Rameswardas (1996).

$$\text{Technological gap index} = \Sigma\left[\frac{R-A}{R}\right] \times 100$$

Where,

R = Maximum possible adoption score that a respondent could be awarded in respect of a component of the technology.

A = Score obtained by a respondent by virtue of his adoption of a component of technology.

3.4.5 Constraints in Cassava Cultivation

The possible constraints were enumerated from related studies in consultation with the developmental personal, social scientists and progressive farmers of a non-sample area (Appendix III). The respondents were asked to record their extent of severity perceived on each statement of constraints. The scoring was done on a five point continuum as severe, very severe, undecided, not severe, not at all severe. With score ranging from 4 to 0. The total score for each of the statements was calculated and ranking of constraints was done.

3.4.6 Reasons for Decline in Area under Cassava Cultivation

In order to identify the various reasons for decline in cassava area the following procedure was adopted.

A list of reasons responsible for cassava area decline was prepared after consulting with the scientists who are working in the relevant fields and some progressive cassava farmers (Appendix IV). More number of reasons were included in the interview schedule as simple and clear statements after reviewing relevant literature and information available from different sources.

The respondents were asked to respond to the item of reason on a five point continuum *viz.*, strongly agree, agree, undecided, disagree and strongly disagree with weightage of 4, 3, 2, 1 and 0 for the statements.

3.4.7 Training Need

Training need is operationally defined as the expressed level of training indicated as required by respondents in each of the training area referred (Anantharaman *et al.*, 1982).

Training need of farmer was assessed in major subject matter areas and specific items using a three point rating scale such as "much needed", "needed" and "not needed" and it was then quantified by assigning scores of 2, 1 and 0, respectively.

3.5 METHODS USED FOR DATA COLLECTION

Interview method of data collection with a well structured interview schedule was followed wherein the researcher could have first hand information from the farmers. Before giving a final shape to the interview schedule, the schedule was pre-tested in a non sample area. Based on the experience from pre-testing, necessary modifications were made. Each respondent was personally contacted and interviewed with the help of the schedule developed for the study. The interview schedule was prepared in English and was translated into Malayalam before administering to the respondents (Appendix V).

3.6 STATISTICAL TOOLS USED FOR THE STUDY

The collected data were analysed using the following statistical tools.

3.6.1 Percentage Analysis

To make comparisons, percentage analysis was done.

3.6.2 Mean

The respondents were classified into categories based on scoring pattern into low, medium and high groups for the variables based on the mean scores after statistical analysis.

3.3.6 Correlation Analysis

To find out the degree of relationship between the dependent variable (technology gap) and the independent variables (socio-personal characteristics) in this study correlation was worked out.

3.6.4 Rank Order Correlation

To find out the region wise correlation of reasons for decline in area under cassava and region wise correlation of training needs of cassava farmers.

Results and Discussion

4. RESULTS AND DISCUSSION

This chapter deals with the results and discussions based on the analysis of data obtained in the study. The results and discussions are presented keeping the objectives of the study in mind. The highlights of the study conducted among 150 beneficiaries and 50 experts are discussed under the following heads.

4.1 Profile characteristics of cassava cultivators

4.2 Production system typology of cassava

4.3 Technology utilization pattern of cassava farmers

4.4 Technology gap

4.5 The constraints in the cassava cultivation as perceived by farmers

4.6 Reasons for the decline in the area under cassava cultivation

4.7 Training needs of farmers in cassava production and processing

4.1 PROFILE CHARACTERISTICS OF CASSAVA CULTIVATORS

In this study, 15 variables have been selected for analysis. Distribution of the respondents according to these characteristics and the discussion relevant to the study are presented in Fig. 1b and in this section.

4.1.1 Age

The details in Table 1 revealed that in hilly region majority of the respondents, (60 percent) belonged to the old age group, 36 per cent of the respondents belonged to the middle age group and only four per cent were in young age category.

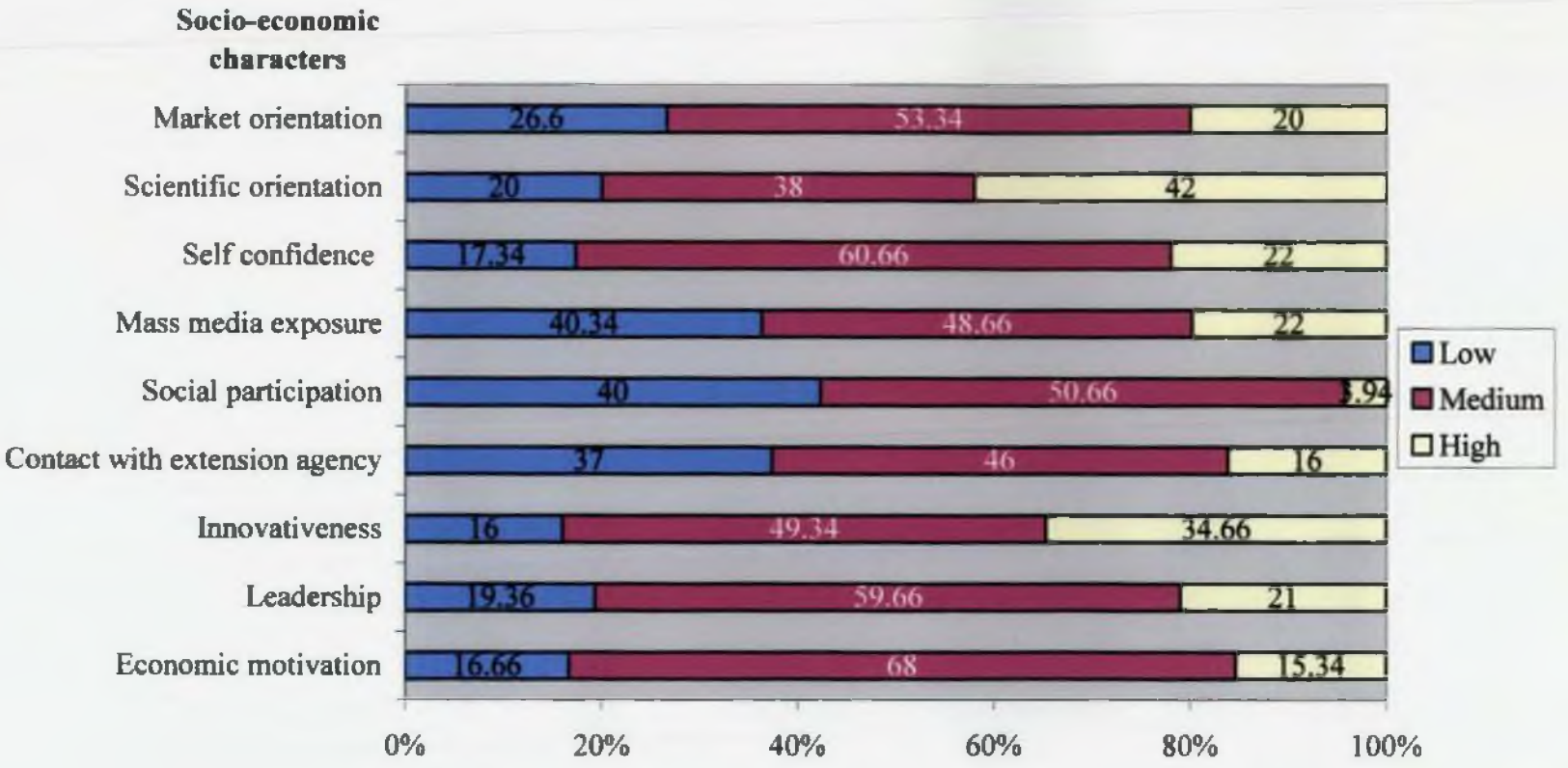


Fig. 1. Distribution of respondents according to their selected socio-economic characteristics

In the case of mid land region 62 per cent of the respondents were in the old age group, 32 per cent in middle group and only six per cent in young age group.

In the case of coastal region also it was noticed that majority of the farmers (52 %) belonged to the old aged group, 40 per cent in middle aged group and only eight per cent in young age group.

When the three regions were taken together majority of the respondents of the three regions belonged to the old age group. This finding reveals that elders have shown more interest to cultivate cassava in Thiruvananthapuram district. The study also indicated that the youngsters have shown less affinity towards the cultivation of cassava.

The finding derives from the findings of Ramanathan *et al.* (1985).

Table 1. Distribution of the respondents with respect to age (n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Young (upto 35)	2	4	3	6	4	8	9	6
Middle (36-50)	18	36	16	32	20	40	54	36
Old (above 50)	30	60	31	62	26	52	87	58
Total	50	100	50	100	50	100	150	100

4.1.2 Educational Status

A cursory view of the Table 2 shows that in the hilly region majority of the respondents (52 %) had education upto secondary level, 34 per cent had upto primary level, 14 per cent of them had collegiate education and there was no illiterate farmer.

In the case of the midland region, 46 per cent of respondents had primary level education, 40 per cent of the respondents had education upto

secondary level, 12 per cent of them had education upto college level and only two per cent of the respondents were illiterate.

In the case of the coastal region also it was noticed that majority of the respondents (56 %) had secondary level of education, 24 per cent had upto primary level education, 18 per cent had college level education and only two per cent of the respondents belonged to the category of illiterate.

This result is a reflection of the higher literacy rate of Kerala state. This result shows that today's farmers are fully educationally forward.

Table 2. Distribution of the respondents according to their educational status

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Illiterate	0	0	1	2	1	2	2	1.33
Primary education	17	34	23	46	12	24	52	35.00
Secondary education	26	52	20	40	28	56	74	49.00
Collegiate education	7	14	6	12	9	18	22	4.67
Total	50	100	50	100	50	100	150	100

4.1.3 Experience in Cassava Cultivation (Years)

It is seen from Table 3 that in hilly region majority of the respondents (52 %) had higher level of experience in cassava cultivation (>25 years), 20 per cent of respondents had 11 to 25 years of experience and six per cent of the respondents had upto five years of experience in cassava cultivation.

In case of the midland region 54 per cent of respondents had more than 25 years of experience, 28 per cent had 11 to 25 years, 14 per cent

had 6 to 10 years and four per cent of the respondents had upto five years of experience in cassava cultivation.

In the coastal region also it was noticed that majority of the respondents (54 %) had more than 25 years of experience, 20 per cent of the respondents had 11 to 25 years, 22 per cent had 6 to 10 years and four per cent of the farmers had upto five years of experience in cassava cultivation.

The results of the study revealed that in all the three regions the majority of the respondents had higher level of experience. This might be due to the fact that cassava was considered as a traditional crop.

Table 3. Distribution of the respondents according to their experience in cassava cultivation

(n=150)

Experience in years	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Upto 5	3	6	2	4	2	4	7	4.66
6 – 10	11	22	7	14	11	22	29	19.33
11 – 25	10	20	14	28	10	20	34	22.66
>25	26	52	27	54	27	54	80	53.35
Total	50	100	50	100	50	100	150	100

4.1.4 Area

As seen from Table 4, in the hilly region majority of the respondents (70 %) had less than 1 acre of land, 16 per cent had 1 to 2 acres, eight per cent had 2 to 3 acres, four per cent had 3 to 4 acres and two per cent respondents had more than 4 acres of land.

In the mid land region it was observed that majority of the respondents (72 %) had less than one acre of land, 18 per cent possessed 1

to 2 acres, 8 per cent had 2 to 3 acres, two per cent of the farmers had more than 4 acres of land.

In case of coastal region also it was noticed that majority of the respondents (80 %) had less than one acre of land. This is also an indication of increased number of small and marginal farmers of Kerala.

When the three regions were taken together the majority of the respondents (74.5 %) had possessed less than one acre of land.

Table 4. Distribution of the respondents according to their area under cassava cultivation (n=150)

Area	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
< 1 acre	35	70	36	72	40	80	111	74.50
1 – 2	8	16	9	18	8	16	25	16.50
2 – 3	4	8	4	8	2	4	10	6.34
3 – 4	2	4	1	2	-	-	3	2.00
> 4	1	2	0	0	0	0	1	0.66
Total	50	100	50	100	50	100	150	100

4.1.5 Scientific Orientation

Data on table 5 show that in the hilly region 40 per cent of the respondents had medium level of scientific orientation, 36 per cent of farmers had high level of scientific orientation and 24 per cent of the farmers had low level of scientific orientation.

In case of the midland region, the majority of the respondents 62 per cent had medium level of scientific orientation followed by 30 per cent low land and 28 percent had high level of scientific orientation.

In the coastal region also it was noticed that majority of the respondents (46 %) had medium level of scientific orientation followed by 32 per cent high level and 22 per cent low land.

Similar finding was reported by Payal (1999).

Table 5. Distribution of the respondents according to their scientific orientation

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	12	24	15	30	11	22	38	25.33
Medium	20	40	21	62	23	46	64	42.67
High	18	36	14	28	16	32	48	32.00
Total	50	100	50	100	50	100	150	100

4.1.6 Contact with Extension Agency

As seen from the Table 6 that in the hilly region majority of the respondents (56 %) had medium land of extension agency contact followed by 30 per cent had low level and 14 per cent had high level extension agency contact.

In the case of the midland region majority of the respondents (40 %) had medium level of extension agency contact followed by 34 per cent low level and 26 per cent had high level of extension agency contact. It is also noticed that in the coastal region nearly half of the respondents (48 %) had low level of extension agency contact, followed by 40 per cent having medium level and eight per cent with high level of extension agency contact.

The message for farmers from extension agencies on cassava crop was much limited compared to other cultivable crops such as rice, coconut, rubber etc. and this could have been the possible reason for the observed result.

Table 6. Distribution of the respondents according to their extension agency contact (n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	15	30	17	34	24	48	56	37
Medium	28	56	20	40	22	40	70	46.36
High	7	14	13	26	4	8	24	16.64
Total	50	100	50	100	50	100	150	100

4.1.7 Economic Motivation

It is seen from the Table 7 that majority (68 %) of the respondents had medium level of economic motivation followed by 17 per cent had low level and 15 per cent had high level of economic motivation. The medium level of innovativeness, knowledge, mass media exposure could have been the reasons for majority of the respondents belonged to the medium category of economic motivation. From the above analysis in all the three regions, majority of the respondents had medium level of economic motivation.

This findings is in confirmity with Arulmurugan (2000).

Table 7. Distribution of the respondents according to their economic motivation

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	9	18	7	14	9	18	25	16.66
Medium	34	68	38	76	30	60	102	68.00
High	7	14	5	10	11	22	23	15.34
Total	50	100	50	100	50	100	150	100

4.1.8 Self Confidence

It can be observed from the Table 8 that majority of the respondents (60.66 %) had medium level of self confidence followed by low (17.34 %0 and high (22 %) level of self confidence. The medium level of self confidence might be due to slow disappearance of future insecurity because it indicated well aware of the economics of cassava cultivation.

Table 8. Distribution of the respondents with respect to self confidence

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	7	14	10	20	9	18	26	17.34
Medium	22	44	33	66	36	72	91	6066
High	21	42	7	14	5	10	33	22.00
Total	50	100	50	100	50	100	150	100

4.1.9 Innovativeness

A cursory view of the Table 9 shows that for all the three regions together nearly half of the respondents had medium level (49.34 %) of innovativeness followed by low (16 %) and high (34.66 %) level of innovativeness.

Medium level of economic motivation, mass media exposure and knowledge might have contributed for medium level of innovativeness.

This finding derives support from the findings of Alagirisamy (1997).

Table 9. Distribution of the respondents according to their innovativeness

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	8	16	10	20	6	12	24	16
Medium	22	44	24	48	28	56	74	49.34
High	20	40	16	32	16	32	52	34.66
Total	50	100	50	100	50	100	150	100

4.1.10 Leadership

It is seen from the Table 10 that for all the three regions together majority of the respondents had high (46 %) level of leadership followed by medium (44 %) and low (10 %), level of leadership.

Medium level of knowledge, innovativeness and mass media exposure might have contributed to the medium level of leadership.

This finding is in line with the finding of Arunkumar (2002).

Table 10. Distribution of the respondents according to their leadership

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	5	10	6	12	4	8	15	10
Medium	23	46	20	40	23	46	66	44
High	22	44	24	48	23	46	69	46
Total	50	100	50	100	50	100	150	100

4.1.11 Knowledge

It could be observed from Table 11 and Fig. 2 that 54 per cent of the respondents possessed high level of knowledge (32 per cent had high and 22 per cent had very high level of knowledge) about cassava cultivation whereas 46 per cent (30 per cent had low and 16 per cent had very low) possessed low level of knowledge.

Though the literacy rate is very high in Kerala that did not reflect in the knowledge level of farmers in scientific cassava cultivation, as about half of the cultivars are having only low knowledge level in the present study. This underscores the significance of future extension interventions focusing on improving the knowledge level of cultivators.

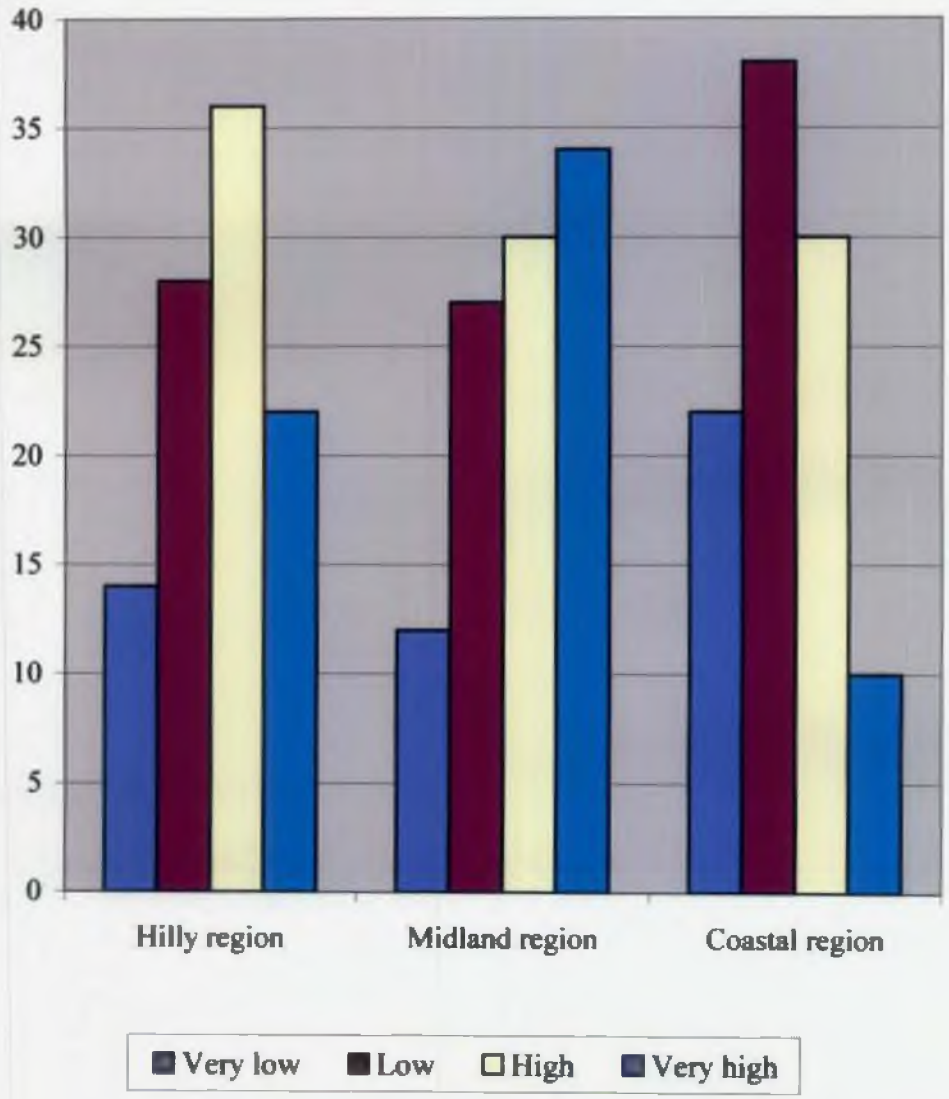


Fig. 2. Distribution of respondents according to their level of knowledge on cassava cultivation

Table 11. Distribution of the respondents according to their level of knowledge

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Very low	7	14	6	12	11	22	24	16
Low	14	28	12	27	19	38	45	30
High	18	36	15	30	15	30	48	32
Very high	11	22	17	34	5	10	33	22
Total	50	100	50	100	50	100	150	100

4.1.12 Market Orientation

Market orientation of the respondents was analysed and the results are presented in Table 12. More than half of the respondents (53.34 %) had medium level of market orientation followed by low (26 %) and high level (20 %)of market orientation.

The medium level of mass media exposure and innovativeness and knowledge might be the reasons for medium level of market orientation among the majority of the respondents.

The finding is in accordance with the one reported by Alagirisamy (1997).

Table 12. Distribution of the respondents according to their market orientation

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	14	28	10	20	16	32	40	26.66
Medium	30	60	29	58	21	42	80	53.34
High	6	12	11	22	13	26	30	20.00
Total	50	100	50	100	50	100	150	100

4.1.13 Mass Media Exposure

Table 13 indicates that nearly half of the respondents (48.66 %) had medium level of mass media exposure, 40.66 per cent had low level and 10.68 per cent had high level of mass media exposure. The limited access to magazines, newspapers and TV might be the reasons for the medium level of mass media exposure observed with majority of the cassava cultivators.

Table 13. Distribution of the respondents according to their mass media exposure

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	18	36	20	40	23	46	61	40.66
Medium	24	48	27	54	22	44	73	48.66
High	8	16	3	6	5	10	16	10.68
Total	50	100	50	100	50	100	150	100

The analysis of the results also indicated that among the various sources of mass media, TV was found to be the most popular and dependable media with a score value of 204 by majority of respondents. The newspaper was found to be the second highest popular mass media with a score of 166, The radio is found to have third most important mass media with a score of 165 and followed by magazines (126), other agriculture magazines (121), books (48) and internet (12).

Table 14 Most popular and dependable mass media channels by the respondents (n = 150)

Mass media	Score	Rank
Television	204	I
Newspaper	166	II
Radio	165	III
Magazines	126	IV
Other agricultural magazines	121	V
Books	48	VI
Internet	12	VII

(Score ranges from 0 – 300)

4.1.14 Social Participation

It is apparent from the Table 15 that majority of the cassava cultivators (50.66 %) had medium level of social participation followed by high (40 %) level and low (9.34 %) level of social participation.

Absence of credible institutions and organisations in the villages and the medium level of extension contact observed could have contributed to the over all low social participation among the respondents.

The finding is similar to that reported by Muthiah (1994) who also observed that majority of the respondents had medium level of social participation.

Table 15. Distribution of the respondents according to their social participation

(n=150)

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Low	5	10	4	8	5	10	4	9.34
Medium	20	40	25	50	31	62	76	50.66
High	25	50	21	42	14	28	60	40
Total	50	100	50	100	50	100	150	100

The analysis of results also revealed that co-operative society is found to have the most popular and accessible community organization with regard to membership, involvement and nature of participation of respondents for social contact with an average score value of 120 followed by Karshika Vikasana Samithy (110), political party (95), farmers / trade union (74), farmers / youth club (59) and others (28).

Table 16. Social organizations used by the respondents

Organisation	Score	Rank
Co-operative society	120	I
Karshika vikasana Samithy	110	II
Political party	95	III
Farmers / trade union	74	IV
Farmers / youth club	59	V
Others	28	VI

4.2 PRODUCTION SYSTEM TYPOLOGY

Production system typology refers to the categorization of cassava cultivation in terms of land (upland, lowland and homestead) (Plate 1), type of cropping components (monocropping, intercropping and mixed cropping) and type of cropping objectives (commercial (Plate 2), semi-commercial and subsistence).

4.2.1 Distribution of Land Holdings and Area in Various Cassava Production Systems According to Cropping Component and Type of Land

A perusal of the data presented in the table 17 indicated that 49.24 per cent of the total area was cultivated as pure crop, 22.66 per cent area was occupied as intercrop, 9.46 per cent of the area was coming under mixed crop and the remaining 18.64 per cent of total area was under homestead system.

It could be observed from the table that a total of 128 farms were identified as low land pure crop and upland pure corp. This constitutes 27 per cent of the total number of farms.

The study also identified 126 intercropped farms and 83 mixed cropped farms. This constitutes 26 per cent and 17 per cent of total number of farms, respectively. Apart form this, 150 homestead farms were also identified its share was noticed as 18.64 per cent of total farms. Altogether, 487 number of farms were identified with various cropping patterns like lowland pure crop, upland pure crop, lowland intercrop, upland intercrop, lowland mixed crop, upland mixed crop and upland homestead.

a. Upland cassava cultivation

b. Lowland cassava cultivation

c. Homestead cassava cultivation

Plate 1. Cassava production system typology

Plate 2. Field view of commercial cassava cultivation

Table 17 Distribution of the land holdings and area in various cassava production systems according to cropping component and type of land

Cropping pattern	Low land (cents)				Upland (cents)				Total			
	No. of farm	Per cent	Area	Per cent	No. of farm	Per cent	Area	Per cent	No. of farm	Per cent	Area	Per cent
Pure crop	70	55	3525	74	58	16	2745	35	128	27	6270	49.24
Intercrop	30	24	1005	24	95	27	1883	24	126	26	2888	22.66
Mixed crop	27	21	247	5	56	16	960	12	83	17	1207	9.46
Homestead	-	-	-	-	150	41	2375	29	150	30	2375	18.64
Total	127	100	4777	100	360	100	7963	100	487	100	12740	100

4.2.2 Production System Typology based on Type of Land and Cropping Component

It is observed from the Table18 and Fig. 3 that 27.66 per cent of the total area was being cultivated as lowland pure crop, followed by 21.54 % upland pure crop, 18.64% upland homestead, 14.70% upland intercrop, 7.80 per cent lowland intercrop, 7.50% upland mixed crop and 1.90% lowland mixed crop.

The greater adoption of the pure cropping system might be due to the increasing trend of commercialization and industrialization of cassava. The results also revealed that the respondents had shown interest in cultivating cassava as a pure crop in lowland. This might be due to the conversion of traditional paddy field for cultivating cassava as pure crop in lowland, aiming more economic returns. Formerly cassava was largely being cultivated in upland condition.

The finding is in accordance with the findings of Ramanathan and Anantharaman (1996).

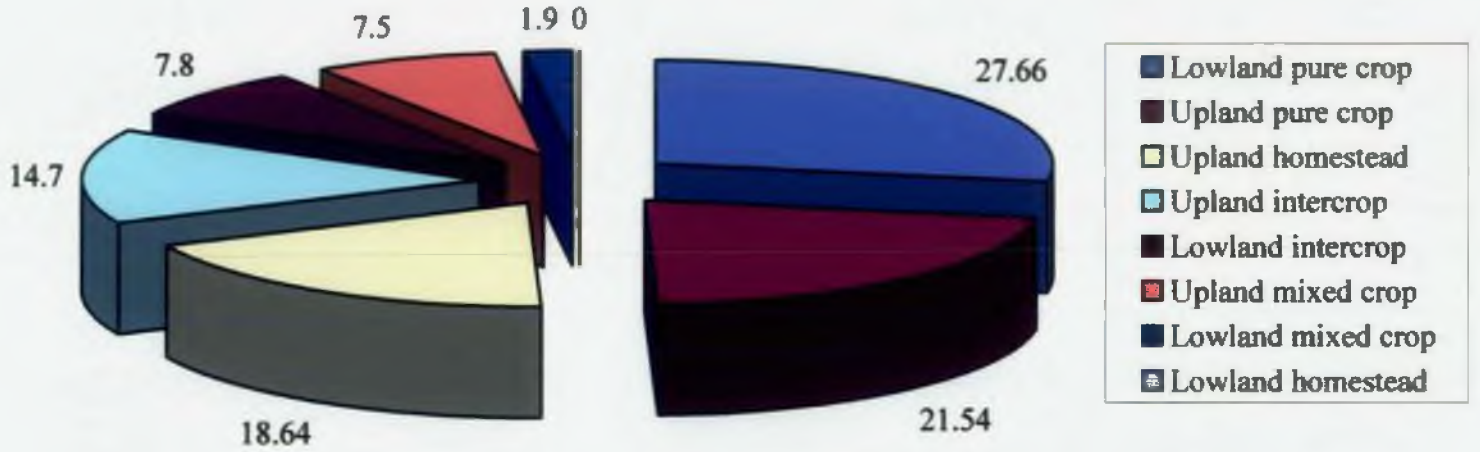


Fig. 3. Production System Typology based on Type of Land and Cropping Component

The study also indicated that all the respondents had upland homestead production system with an average area of 13.83 cents which constituted 18.64 per cent of total area.

The other major finding was that the majority of the respondents had more than one farm in addition to upland homestead. The results of the analysis pointed out that the farmers were well aware of the benefits of intercropping cassava under perennials. It is estimated that 22.5 per cent of total area was cultivated as intercrop (Ravindran, 2003).

The study also revealed that the respondents followed the practice of mixed cropping. 7.5 per cent of area was cultivated as upland mixed crop and negligible share of area (1.9 %) occupied by lowland mixed crop. The low adoption of lowland mixed crop could be the reason for the differences in duration of other companion crops. It might be hindering various cultural operations such as ploughing, planting, weeding and other intercultural operations.

Table 18 Production System Typology based on Type of Land and Cropping Component

Production system	Area (in acres)	Per cent	Rank
Lowland pure crop	3525	27.66	I
Upland pure crop	2745	21.54	II
Upland homestead	2375	18.64	III
Upland intercrop	1883	14.70	IV
Lowland intercrop	1005	7.80	V
Upland mixed crop	960	7.50	VI
Lowland mixed crop	247	1.90	VII
Lowland homestead	0	0	VIII
Total area	12740	100	

4.2.3 Distribution of the Farmers based on Cropping Objectives

A perusal of the data presented in Table 19 and Fig. 4 reveals that majority of the respondents (42.67 %) belonged to the category of commercial farmers followed by 34.66 per cent coming under semi-commercial and 22.67 per cent belonged to the subsistence group.

In order to identify the category to which the farmers belong, on the basis of cropping objectives (if a farmer sells more than 50 percent of the produce, he is included in the category of commercial farmer, between 20-25 percent as semi-commercial farmers and if he sells less than 20 per cent, he is included as subsistence farmer).

The reasons why more respondents fell under the commercial category might be relatively high price of cassava in local market.

The region wise distribution of the respondents also indicated that in hilly region majority (42 per cent) of farmers were under commercial category. The farmers belonging to semi-commercial and subsistence category were 36 per cent and 22 per cent respectively. In midland region majority of farmers (38 %) belonged to commercial category and 34 per cent and 28 per cent belonged to semi-commercial and subsistence category respectively.

In coastal region also majority (48 %) of the farmers belonged to commercial, 34 per cent and 18 per cent belonged to semi-commercial and subsistence categories respectively.

Table 19 Distribution of the respondents based on cropping objectives

Category	Hilly region		Midland region		Coastal region		Total	
	Number of farmer	%	Number of farmer	%	Number of farmer	%	Number of farmer	%
Commercial	21	42	19	38	24	48	64	42.66
Semi-commercial	18	36	17	34	17	34	52	34.66
Subsistence	11	22	14	28	9	18	34	22.68
Total	50	100	50	100	50	100	150	100

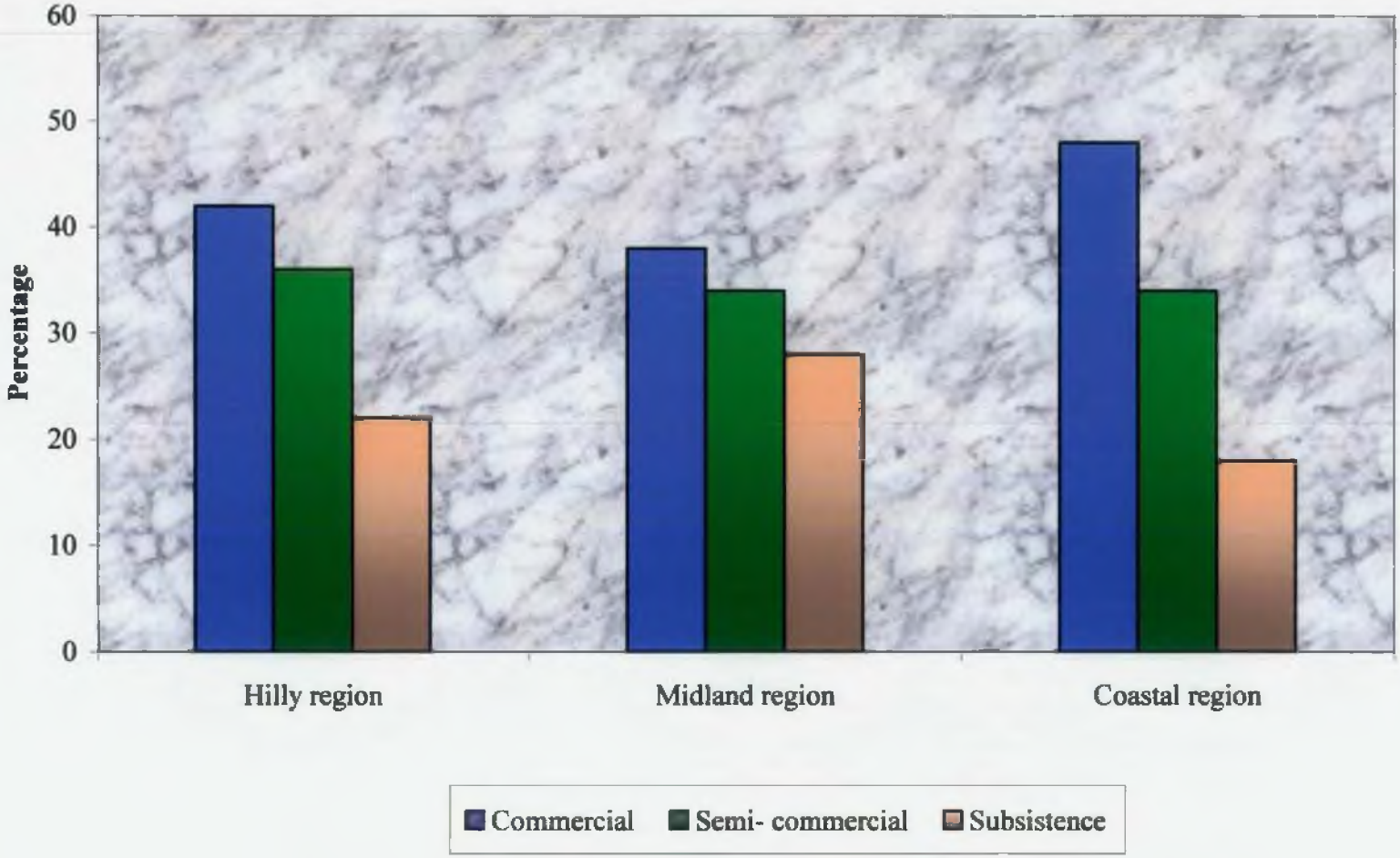


Fig. 4. Region wise distribution of the respondents based on cropping objectives

4.2.4 Geographical Distribution of Areas under Cassava

Table 20 revealed that majority of the area (36.75) was coming under the hilly region. In the case of coastal region it was noticed as 33.3 % and 29.94 % of total area was coming under midland region.

The reason for majority of areas coming under hilly region might be due to the higher per capita land availability (31.21 per cent). The study also identified that rubber and coconut are the major perennial crops in the hilly region. The farmers opined that during replanting season of rubber, majority of the farmers used to cultivate cassava as an intercrop in rubber plantation upto two to three years. This might be the other reason for the greater proportion of the cassava area being occupied under hilly region.

Table 20 Geographical distribution of areas under cassava

Methods of land preparation	Lowland		Upland				Total	
	Area	%	Homestead		Others			
			Area	%	Area	%	Area	%
Hilly	1294	27	1205	50	2183	39	4682	36.75
Midland	1490	31	600	26	1725	31	3815	29.94
Coastal	1993	42	570	24	1680	30	4243	33.31
Total	4773	100	2375	100	5588	100	12740	100

4.2.5 Areas and Production of Cassava in Different Geographic Categories

Table 21 revealed that slight variation was observed in the case of region wise production of cassava. Though the total cultivated cassava area was observed more in hilly region (36.75). The production of cassava was found to have remarkable increase in coastal region

(36.92 %) followed by hilly region (32.52 %) and in midland region (30.56 %). The higher level of production in the coastal region might be due to the presence of fertile, loose, friable, sandy soil which enables the enhancement of tuberisation and easy bulkiness. The study also noted that the productivity of cassava in the coastal region was 17.10 per cent t ha^{-1}, it was slightly higher than that of the other two regions *i.e.*, 16.12 t ha^{-1} for the midland region 13.97 t ha^{-1} for midland region. The reason for the difference in productivity also might be due to the fertility nature, texture and structure of the sandy soil of the coastal region which might be congenial to the growth and development of cassava tubers.

Table 21 Area and production of cassava in different geographic categories

Type of region	Area (cents)	Per cent	Production (t)	Per cent	Productivity (t ha^{-1})
Hilly	4682	36.75	261.80	32.52	16.12
Midland	3815	29.94	246.03	30.56	13.97
Coastal	4343	33.31	297.17	36.92	17.10
Total	12740	100	805	100	15.79

4.2.6 Distribution of Cassava Area under Hybrid Varieties

It could be observed from Table 22 that 29.60 per cent of total area was being occupied by the variety, Sree Jaya followed by Sree Vijaya (26.06 %), Sree Visakh (23.03 %), H 97 (10.80 %) and H. 165 (10.42 %).

The greater adoption of Sree Jaya might be due to the red rind colour of tubers resembling the tubers of M_4 and its excellent cooking quality.

The greater adoption of Sree Visakh under lowland condition might be due to the better performance and its adaptability to the low lying areas. The reason for the lesser adoption of H 97 and H 165 might be due to the bitterness of tubers, lengthy duration and less starch content. The farmers also opined that the performance of the above two varieties are excellent and suited for dry preparation *i.e.*, for making chips.

Table 22 Distribution of cassava area under hybrid varieties

Category	Lowland		Upland		Total	
	Area (in cents)	%	Area (in cents)	%	Area (in cents)	%
Sree Jaya	445	20	1025	38	1470	29.60
Sree Vijaya	615	28	675	25	1290	26.06
Sree Visakh	660	29	480	17	1140	23.03
H 97	245	11	290	11	535	10.80
H 165	270	12	245	9	515	10.42
Total	2235	100	2715	100	4950	100

4.2.7 Distribution of Area under Local Varieties

It could be seen from Table 23, that majority of the area (26.50 %) was being occupied with variety M_4 followed by Kalian (10.65 %), Sundarivella (6.03 %), Anakomban (7.50 %), Ambakadan (7.50 %), Kasalachadi (5.45 %), Kariyilaporian (6.35 %), Njaruku (4.68 %), Manikuttan (4.60 %) and Marvanis (5.84 %). The remaining 15.15 per cent of the area was being occupied with some other local varieties *viz.*, Karukannan, Muttavian, Anamaravan, Singapore Vella, Elakarupan, Ethakapuzhukan, Nilgiri, Mankozhunthan, Kodanvella, Kandharipadappan, Parankayan Vella, Mavelikara Kappa etc.

Farmers opined that the cooking quality of the M_4 was very excellent and it can perform very well under different production systems. Respondents had also pointed out that the cooking quality of other varieties deteriorated under prolonged rainy season whereas the starch depletion is very less in the case of M_4. This might be reason for the greater adoption of the particular variety.

Table 23 Distribution of area under local varieties

Sl. No.	Category	Lowland		Upland		Total	
		Area	%	Area	%	%	%
1	M_4	980	25.68	1085	27.29	2065	26.50
2	Kalian	290	7.60	540	13.58	860	10.65
3	Sundarivella	245	6.42	225	5.66	470	6.03
4	Anakomban	240	6.24	345	8.67	585	7.50
5	Anamaravan	230	6.02	195	4.90	425	5.45
6	Kasolachadi	375	9.82	190	4.77	656	7.25
7	Kariyilaporian	235	6.15	260	6.54	495	6.35
8	Njaruku	140	3.66	225	6.55	365	4.68
9	Manikutan	200	5.24	165	4.16	365	4.60
10	Marvanis	275	7.32	180	4.52	455	5.84
11	Others	605	15.85	565	14.26	1170	15.15
	Total	3815	100	3975	100	7790	100

4.2.8 Distribution of Geographic Region Specific Prominent Varieties

From Table 24, it could be seen that the hybrid varieties are predominant in coastal region and uniformly distributed in hilly and midland region. The higher adoption of hybrid variety under coastal region might be due to the proximity of coastal areas (comprising

Kazhakuttom and Pothencode) to Central Tuber Crops Research Institute, it helps easy dissemination of released varieties and may cause more predominant in nearby areas.

Regarding the local variety M_4 was uniformly distributed under various geographic regions. The uniform adoption of this variety might be due to its excellent cooking quality and wide range of adaptability.

Some other region specific varieties are Manikuttan which is predominant in coastal area, Njaruku in midland, Marvanis in hilly region, Kariyilaporian in coastal region, Ambakadan in midland region, Kasalachadi in coastal region and Sundarivella is predominant in hilly region.

Table 24 Distribution of geographic region specific prominent varieties

Items	Hilly region	Midland region	Coastal region
Hybrid varieties	UD	UD	P
Local varieties a. M_4	UD	UD	UD
b. Kalian	UD	UD	UD
c. Manikuttan	R	R	P
d. Njaruku	R	P	R
e. Marvanis	P	R	R
f. Kariyilaporian	R	UD	P
g. Ambakadan	R	P	R
h. Kasalachadi	R	R	P
i. Sundarivella	P	UD	UD

(UD – Uniformly distributed, R – Rarely, P – Predominant)

4.2.9 Utilization Pattern of Cassava

An observation of the data presented in Table 25 and Fig. 5 explains the total production of cassava by 150 respondents was 805 tonnes and this accounts 5.36 tonnes production per farmer. In the case of total production, the contribution of coastal area was more *i.e.*, 297.17 tonnes followed by hilly region, 261.80 tonnes and midland region it was observed as 246.03 tonnes.

Regarding the consumption of produce the observation made clear that 19.62 per cent of total produce was being consumed as raw and 5.21 per cent consumed as processed. The majority of farmers had shown interest to consume cassava as raw. The reason for less consumption of processed produce might be due to the inadequate post harvest technologies in this connection.

The examination of region wise consumption of cassava reveals that the people of hilly areas consumed more tubers *i.e.*, 7.2 per cent as raw and 1.99 per cent as processed. 6.33 per cent of total cassava was being consumed as raw and 1.77 per cent as processed by the people of midland region.

Even if the production of cassava was more, lower rate of consumption was noticed in coastal region *i.e.*, 5.7 per cent as raw and 1.47 per cent as processed. The reason for more consumption of cassava at hilly area might be due to the employment nature of people *i.e.*, the majority of them are agricultural labourers or any other working class.

A perusal of the data presented in Table 25 indicated that, 56.64 per cent of produce is marketed as raw and 18.53 per cent as processed. Lesser adoption in marketing of processed produce might be due to the unavailability of adequate post harvest technologies and the easy perishable nature of tubers.

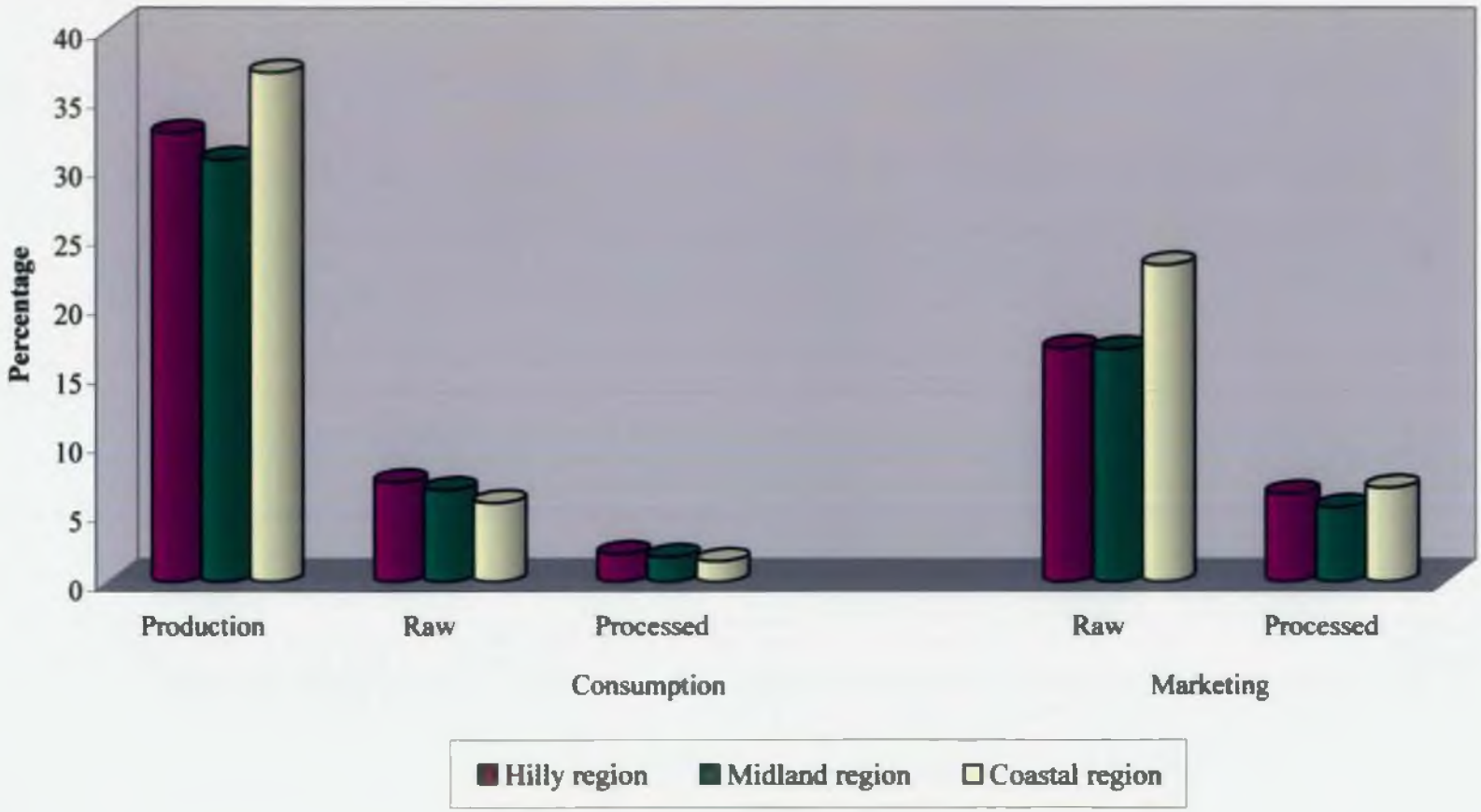


Fig. 5. Utilization pattern of cassava

Regarding the region wise marketing of produce 22.94 per cent of the total cassava was being marketed as raw and 6.78 per cent as processed in coastal region. It is also observed that 16.89 per cent marketed as raw and 6.35 per cent as processed in hilly region and in midland region it was 16.81 per cent and 5.36 per cent marketed as raw and processed respectively.

Table 25 Utilization pattern of cassava

Items		Hilly region	Per cent	Midland region	Per cent	Coastal region	Per cent	Total	Per cent
Production (t)		261.80	32.52	246.03	30.56	297.17	36.92	805	-
Consumption (t)	Raw	58.66	7.20	53.38	6.63	45.96	5.70	158	19.62
	Processed	16.04	1.99	14.30	1.77	11.86	1.47	42	5.12
Marketing (t)	Raw	135.97	16.89	135.33	16.81	184.70	22.94	456	56.64
	Processed	51.13	6.35	43.21	5.36	54.65	6.78	149	18.53

4.2.10 Distribution of Area based on Respondent's Land Ownership

A cursory view of the Table 26 reveals that vast majority of the respondent areas (77.87 %) was possessed by the actual ownership it self and 22.13 per cent of land was being cultivated as leased in. The detailed comparison with the various production system according to the ownership, found that 21.69 per cent of the lowland cassava area cultivated as owned and 15.54 per cent of the area was cultivated as leased in. In the case of upland more than one third of the area (37.51 %) coming under the category of owned and only 6.59 per cent belonged to the category of leased in under homestead production system there was no leased in areas the entire homestead area (18.64 %) coming under the category of owned land.

Table 26 Distribution of area based on respondents land ownership

Type of land	Owned		Leased in	
	Area (cent)	Per cent	Area (cent)	Per cent
Lowland	2050	21.69	1980	15.54
Upland	4780	37.54	840	6.59
Homestead	3090	18.64	-	-
Total	9920	77.87	2820	22.13

4.3 TECHNOLOGY UTILIZATION PATTERN OF CASSAVA FARMERS

Technology utilization pattern implies the nature, variations and extent of use of cassava cultivation. This descriptive analysis of different improved practices helps extension workers, policy makers, research agenda setters and other concerned to modify the research and extension programmes (Sethy *et al.*, 1984). This chapter deals with the examination of nature and extent of use of various recommended technologies in different production system *viz.*, lowland, upland and homestead.

4.3.1 Selection of Variety According to its Use

Observation regarding selection of varieties revealed that 28 per cent of the farmers select cassava variety fully according to its use whereas 51 per cent of farmers select partially according to its use. But 21 per cent of farmers did not select cassava variety according to its use.

4.3.2 Knowledge about Characteristics of Variety

It could be observed that fairly high proportion of respondents (79 %) had though knowledge about characteristics of varieties. Similar findings were recorded by Arunkumar (2002).

4.3.3 Spread of Cassava Varieties

4.3.3.1 Local Varieties

In order to identify the technology utilization pattern the total study area was classified under two major sections *i.e.*, upland and lowland. The upland is again bifurcated as upland homestead and others.

A curser view of the Table 27 showed that variety M_4 was cultivated in larger proportion both in lowland and upland. In lowland it is estimated as 26 per cent, in upland homestead it was 34 per cent and in other upland area it was figured as 23 per cent.

It was also observed that 26 per cent of total area was being occupied by M_4 variety followed by Kalian 11 per cent, Sundarivella 6 per cent, Kasalachadi 7 per cent, Kariyilaporian 6 per cent and others 44 per cent (Karukannan, Muttavian, Anamaravan, Singapore vella, Elakarupan, Ethakapuzhakan, Nilagiri, Undakannan vella, Kodanvella, Kandharipadappan, Parankayanvella, Mavelikarakappa etc.).

The higher level of adoption of M_4 might be due to the excellent cooking quality and its better performance irrespective of the type of land.

Table 27 Spread of local cassava varieties

Category	Lowland		Upland		Others		Total	
	Area (cents)	%	Homestead area (cents)	%	Area (cents)	%	Area (cents)	%
M_4	980	26	450	34	605	23.58	2035	26
Kalian	290	8	290	21	250	9.74	960	11
Sundharivella	245	6	110	7.8	115	4.48	470	6
Kasalachadi	375	10	-	-	190	7.40	565	7
Kariyilaporian	240	6	120	8.2	140	5.45	500	6
Others	1685	44	410	29	1265	49.35	3360	44
Total	3815	100	1410	100	2565	100	7790	100

4.3.3.2 Hybrid Varieties

It could be observed from Table 28 that 29.60 per cent of total areas being occupied by Sree Jaya followed by Sree Vijaya (26 %), Sree Visakh (23 %), H 97 (11 %), H 165 (10.40 %). The greater adoption of Sree Jaya might be due to the red rind colour of tubers resembling with the tubers of M_4 and its excellent cooking quality. The reason for the lesser adoption of H 97 and H 165 in homestead might be due to the bitterness of tubers, lengthy duration and less starch content. The farmers also opined that the performance of the above two varieties are good and suited for dry purpose.

Table 28 Spread of hybrid cassava varieties

Variety	Lowland		Upland		Others		Total	
	Area (cents)	%	Homestead area (cents)	%	Area (cents)	%	Area (cents)	%
Sree Jaya	445	20	480	43	545	34	1470	29.60
Sree Vijaya	615	29.50	340	31	335	21	1290	26.00
Sree Visakh	600	27.50	290	26	190	12	1140	23.00
H 97	245	11.00	-	-	290	18	535	11.00
H 165	270	12.00	-	-	245	15	515	10.40
Total	2235	100	1110	100	1605	100	4950	100

4.3.4 Selection of Stems and Setts Preparation

Right method of selection of setts was adopted by 82 per cent of the respondents as majority of respondents had knowledge about this practice, they might had adopted the recommended method of setts selection. Majority of the respondents (69.27 %) used to select stems having 2 to 3 cm diameter. While selecting setts majority (78 %) of the respondents had discarded the woody basal portion and tender top portion of the stems.

Whereas a narrow majority (22 %) had neglected the above selection criteria.

The recommended practices with respect to selection of stem and sett preparation are mostly similar to the practices traditionally being followed by the farmers, that might be the reason for the higher level adoption of practices by majority of farmers.

Regarding the length of setts for planting, 73 per cent of the respondents were following recommended standard size of setts (15 to 20 cms) while preparing setts. A vast majority of the respondents (98 %) totally neglected to give the smooth circular cut while preparing setts. The research findings revealed that if provided a circular smooth cut, the setts will give better yield compared to non-circular cut. The non-adopters opined that giving circular cut is cumbersome and time consuming. This might have been the reason for their non-adoption.

4.3.5 Land Preparation and Planting

Nearly half of the respondents (49 %) had fully adopted suitable land preparation methods as recommended. The advantages of this method was known by the respondents. This might have been the reason for such a high degree of adoption. 31 per cent of the respondents partially adopted and 20 per cent of them did not adopt the recommended practice for land preparation and planting.

Table 29 shows that 91 per cent of respondents followed the practice of mound method for planting cassava 6 per cent of them had practiced ridge method and 3 per cent of farmers adopted the flat-bed method in lowland whereas in the case of upland homestead 93.33 per cent had practiced mound method followed by 4.67 ridge method and 2 per cent of respondents adopted the flat-bed method. In the case of others mound method (88 %) followed by 6 per cent of farmers adopted ridge

method, 4 per cent adopted flat bed method and 2 per cent of the respondents practiced pit method for planting cassava.

The results indicated that among the above four planting methods vast majority of the farmers (more than 90 %) had preferred mound method for planting cassava. The higher level of adoption of this practice (mound method) might be due to the most suitability of this particular method to Kerala conditions whereas the other leading cassava producing states like Tamil Nadu and Andhra Pradesh followed the practice of ridge and furrow methods and flat bed methods.

Mound method gives higher yield, provides sufficient space for tuberisation also prevents from the threat of water logged situations and enables earlier harvesting process. This can be attributed to the high popularity and adoption of mound methods.

Regarding the dimensions (size, diameter, height etc.) majority of the farmer respondents stated that they did not follow the recommended dimensions of different land preparation methods.

Table 29 Land preparation and planting

Methods of land preparation	Lowland		Upland			
	Frequency	%	Homestead		Others	
			Frequency	%	Frequency	%
Mound	136	91	140	93.33	131	88
Ridge	9	6	7	4.67	-	6
Flat bed	5	3	3	2	6	4
Pit	-	-	-	-	4	2
Total	150	100	150	100	150	100

4.3.6 Method of Planting

An overwhelming majority (94 %) of the respondents had adopted vertical method of planting in lowland, it was noticed as 96 per cent in upland homestead and 92 per cent of respondents had chosen in other upland situations. This method gives higher yield and most suited to Kerala condition. The advantages of this method was very much known by the respondents which might be the reason for such a high degree of adoption. Only a narrow percentage (<10 %) of respondents had selected slanting method of planting in contour region.

Table 30 Method of planting

Planting Methods	Lowland		Upland			
	Frequency	%	Homestead		Others	
			Frequency	%	Frequency	%
Vertical	142	94	144	96	138	92
Slanting	8	6	6	4	18	8
Horizontal	-	-	-	-	-	-
Total	150	100	150	100	150	100

4.3.7 Depth of Planting

A fairly higher proportion of respondents (68.38 %) had fully adopted suitable planting depth as recommended (4 to 6 cm) the higher adoption is due to the knowledge about the benefits of this practice. 21.67 per cent of respondents had partially adopted and only 10 per cent of respondents did not follow recommended depth for planting cassava (Plate 3).

4.3.8 Spacing

More than 50 per cent (51.60%) respondents had fully adopted recommended spacing (75 x 75 cm for non-branching/erect and 90 x 90 cm for branching). The farmers opined that the optimum population could

Plate 3. Planting of cassava setts

Plate 4. Cassava as intercrop

be maintained only by adopting right spacing, 20 per cent of the respondents had partially adopted the recommended spacing 28.40 per cent of the respondents were non adopters of recommended spacing. The non-adopters opined that closer spacing helps the farmers to do any gap filling. Non-availability of trained labourers was also the reason for not adopting the recommended spacing.

The finding is in accordance with the finding of Arunkumar (2002).

4.3.9 Intercropping

The results of the analysis with regards to intercropping mainly classified under two categories such as cassava as intercropping in coconut garden and vegetables intercropped with cassava. It is observed that 80 per cent of the respondents had adopted the practice of intercropping.

It can be seen from Table 31 that 329 farms possessed by 150 respondents had been occupied with various vegetables as intercropped under cassava. Among these vegetables amaranthus was cultivated in more number of farms (*i.e.*, 104 farms). This constituted 31.61 per cent. The other major intercrops were cowpea (24.31 %), amorphophallus (12.12 %), colocasia (10.63 %), groundnut (4.25 %) and other vegetables (17.05 %).

4.3.9.1 Vegetable as Intercropped under Cassava

Table 31 Vegetable as intercropped under cassava

Crops	Number of farms	Percentage
Cowpea	80	24.31
Amaranthus	104	31.61
Colocasia	35	10.63
Amorphophallus	40	12.12
Groundnut	14	4.25
Others	56	17.05
Total	329	100

4.3.9.2 Cassava as Intercropped under Perennials

It is observed from Table 32, 22.66 per cent of the total study area (*i.e.*, 12470 cents) was being occupied cassava as intercrop (Plate 4). This was 7.88 per cent coming under lowland and 14.64 per cent under upland condition. In addition to this 40 per cent of the total homestead area was also occupied as intercrop.

Table 32 Cassava as intercropped under perennials

Category	Lowland		Upland		Total	
	Area	%	Area	%	Area	%
Intercrop	1005	7.88	1883	14.78	2888	22.66
Homestead	-	-	2375	18.64	2375	18.64
Pure crop	3525	27.66	2745	38.66	6270	49.24
Mixed crop	247	1.93	960	7.53	1207	9.46
Total					12740	100

4.3.10 Application of FYM

The right method of application of farmyard manure was adopted by only 22 per cent of the respondents 65 per cent of respondents were applying farmyard manure as more than or less than recommended dose where as 13 per cent of the respondents abstained from applying farmyard manure due to unavailability.

Table 33 Application of FYM (n = 150)

Sl. No.	Dose applied	Frequency	Percentage
1	Full recommended dose	33	22
2	Partially recommended dose	97	65
3	Non-adoption	20	13

4.3.11 Application of Inorganic Fertilizers

More than three fourth of the respondents (78.92 %) followed the practice of applying inorganic fertilizers (Plate 5). The higher rates of adoption might be due to the greater awareness of this practice.

It is also seen that 52 per cent of the respondents were applying fertilizers in two split doses *i.e.,* first dose was at one month after planting and second dose at two to three months after planting. The entire quantity of mussoriephos and half dose of urea and half dose of Muriate of potash were applied as basal and remaining half of urea and MOP applied as top dressing at two to three months after planting.

4.3.11 Method of application

Table 34 Method of application (n = 150)

Sl. No.	Forms of fertilizer	Frequency	Percentage
1	Straight fertilizer	94	62.64
2	Complex fertilizer	56	37.36

The majority of the respondents (62.64 %) were applying straight fertilizers (urea, mussoriephose, MOP) and 37.36 per cent of respondents applying complex fertilizer (10 : 5 : 20, Factomphose, Vijay, 17 : 17 : 17 etc.) as majority of the farmers had the knowledge about the economy of the fertilizers. This could be reason for more adoption of straight fertilizer.

This finding is in accordance with the findings of Subashini (1996).

4.3.12 Weeding and Earthing Up

More than 50 per cent (52 %) of the respondents had followed the recommended practice of weeding and earthing up (Plate 6). This method gives higher yield and saves crops free of weeds and the other advantages

Plate 5. Application of inorganic fertilizers

Plate 6. Weeding and earthing up

of this method was known by the respondents. This might have been reason for such a high degree of adoption. As weeding and earthing up is synchronized with the application of fertilizers this operation is also repeated twice (one month after planting and three months after planting).

Among the 150 respondents only 4 per cent of them had used chemicals for weeding. The vast majority (86 %) of respondents had been practicing hand weeding and remaining 10 per cent, neither used the practice of hand weeding nor chemical weeding. The farmers opined that the use of chemicals leads environmental hazards, water pollution and also it requires skilled labourers. Further they claimed that the application of weedicides (round up, 2,4-D, Gramexon etc.) will not loosen the soil for enhancing tuberisation.

The above findings reveal that the higher degree of economic and ecofriendly consciousness of farmers might be due to the greater knowledge level of respondents.

4.3.13 Cassava Mosaic Management

Regarding the management of mosaic disease 58 per cent of the respondents were least bothered about the use of disease free planting. For planting the farmers had been selecting stems from previous crops or purchased from neighboring farmers with or without mosaic disease. According to farmers' opinion the slight incidence of mosaic may not economically affect the yield of crops.

Only 33 per cent of the respondents had adopted the recommended resistance varieties *viz.*, H. 226, H 97 and H 165. This might be due to the least knowledge level of recommended varieties by the respondents.

Less than 10 per cent (8.33 %) of the respondents had followed the practices of rouging out the infected plants and followed strict field sanitation measures for controlling mosaic disease.

More than 50 per cent (52 %) of the respondents used to keep the field free of self sown cassava plant and prompt disposal of cassava

residues which might serve as a source of inoculum and help the spread of disease. This practice was done at the time of weeding and earthing up.

Only 10 per cent of the respondents had followed the practice of spraying insecticide (*viz.*, Malathion, Roger, Ekalux, Dimecrone etc.) to control vector population (whitefly) thereby minimizing disease spread. This lower rate of adoption of this practice could be reason for lesser knowledge about the role of whitefly which enhance the dissemination of disease. Though the cassava mosaic disease was found to be severe in the study area, the adoption of chemical plant protection measures observed to be very low. They further claimed that the chemical application results prolonged sustainability of toxicity in tubers. This could have motivated farmers to abstain from the use of chemicals whereas in Tamil Nadu and Andhra Pradesh the rate of application of chemicals for controlling whitefly was found to be high (Arunkumar, 2002).

This finding is in accordance with the findings of Subhashini (1996).

Farmer had a strong belief that there was not much yield reduction due to mosaic disease and hence the slow rate of adoption of control measures.

Table 35 Cassava mosaic management

Practices for controlling cassava mosaic disease	Extent of utilization (%)	
	Yes	No
Using disease free planting materials	58	42
Growing field tolerance varieties like H 97, H 165	33	67
Rogue out the infected plants and follow field sanitation measures	9.87	90.13
Prompt disposal of cassava residues	22	48
Spray insecticide like Rogger, Diamacrone etc.	10	90

4.3.14 Time of Harvesting

More than three fourth (82.33 %) of the respondents harvested the tubers at the recommended time of harvesting (Plate 7). The remaining 18 per cent of the respondents were non-adopters. Some farmers do not harvest the crop when there is low price in the market or less demand, they leave the tubers in field upto a month or two. This could be the reason for non-adoption by 20 per cent of the respondents.

4.3.15 Storage of Planting Material

With regard to the storage of planting materials, 57 per cent of the respondents were least bothered about the storing of harvested setts as in recommended devices *viz.*, in thatched shed or under well aerated shaded condition. The lower degree of adoption might be due to the low knowledge about recommended practice. Remaining 43 per cent of the farmers were keeping their harvested setts under trees in field itself in upright positions (Plate 8 and 9).

Similar finding was reported by Sakthivel (2000).

4.4 TECHNOLOGY GAP

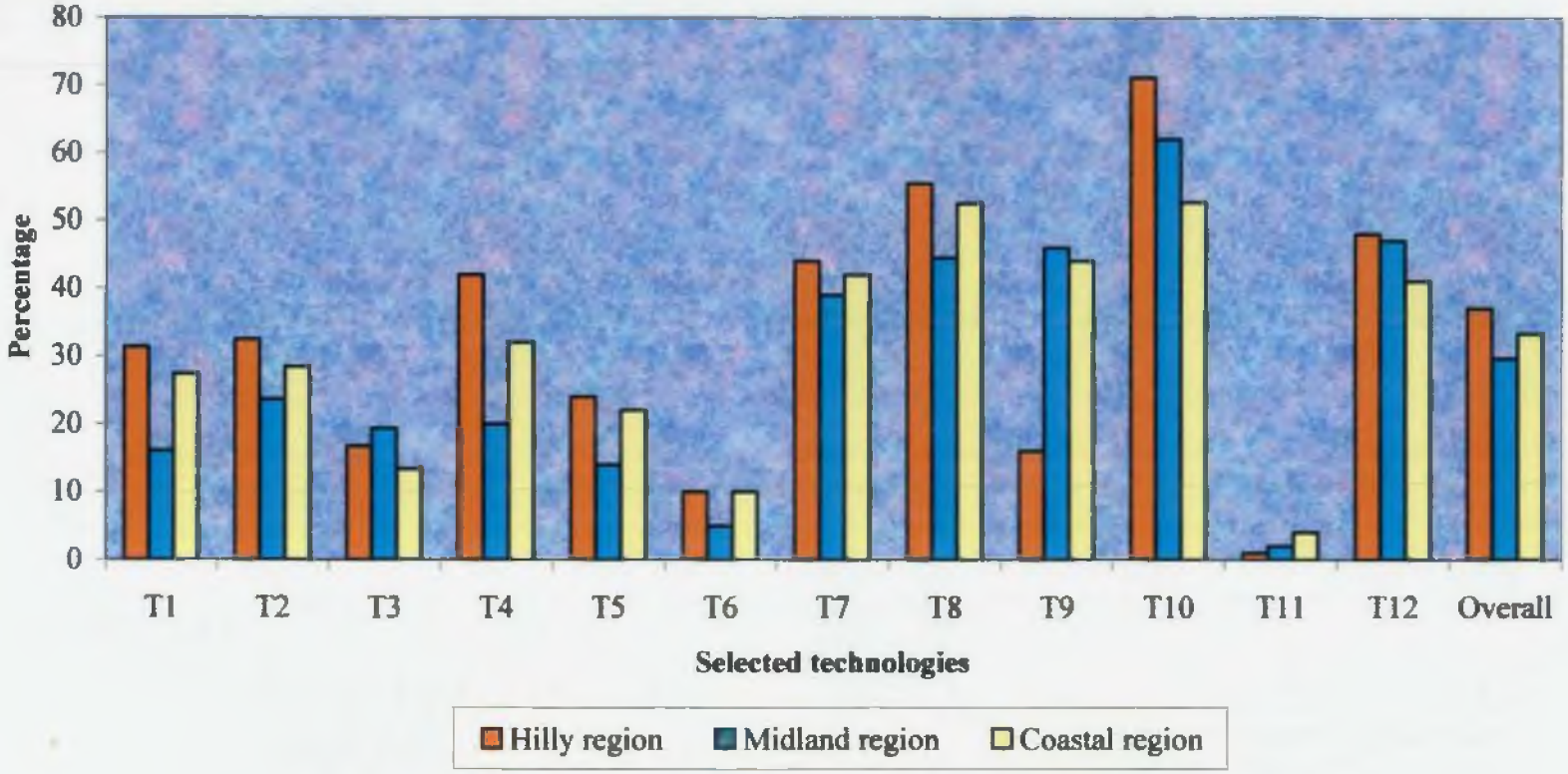
Analysis of data on technology gap (Table 36 and Fig. 6) revealed that there exists a great disparity between technologies as well as regions. Hilly region was found to have experienced grater average technology gap (37%) followed by coastal region (33%) and midland region (30%). The farmers in midland region were found to have higher level of adoption as far as technologies are concerned with an average technology gap score of 30 per cent.

The 11th technology *i.e.*, time of harvesting was the most adopted technology among the farmers irrespective of all the regions. Technology 6th *i.e.*, Inter cropping was also found no significant variation with T 11 as far as technology gap is concerned. T 3 *i.e.*, land preparation and

Plate 7. Harvesting of cassava

Plate 8. Storage of planting material

Plate 9. Marketing of cassava



T1	Selection of Varieties	T7	Application of FYM
T2	Selection of items and sett preparation	T8	Application of inorganic fertilizer
T3	Land preparation and planting	T9	Weeding and inter-culturing
T4	Depth of planting	T10	Cassava mosaic management
T5	Spacing	T11	Time of harvesting
T6	Inter cropping	T12	Storage of planting materials

Fig. 6. Region wise distribution of technology gap

planting also seemed to have attained higher level of adoption irrespective of regions.

This analysis calls for grater focused attention and action on the part of extension functionaries. Technologies namely cassava mosaic management and application of inorganic fertilizers. Storage of planting material and application of FYM registered little popularity among the farmers resulting in a higher technology gap score of 62, 50, 45 and 41 respectively.

Regarding the T 10 (cassava mosaic management) found to have experienced grater technology gap in all the three regions the mosaic disease is the most prevalent fatal disease of the crop and its control will have a greater impact on the level of returns to the farmers. Though technologies for effective prophylactic vector control measures are readily available, its effectiveness will depend on the community collective linkages among farmers beneficiary research system, delivery or extension system and user system needed in this area.

It may be noted that technology 12 (storage of planting materials) is low cost and easily applicable. Still farmers are reluctant to adopt this technology due to un awareness of the beneficial effects of this technology.

The technology 7and 8 (application of FYM and application of inorganic fertilizer) are found to have lesser appeal among farmers. Agronomic practices have a strong barring on the cost aspects of cultivation. Farmyard manure is increasingly becoming costlier and less available. Recent vertical hike in the price of fertilizers also hindered its application. All the above factors had contributed to the wide technology gap with regards to the technology 7 and 8.

Table 36 Region wise distribution of technology gap

Sl No	Selected Technologies	Hilly region	Midland region	Coastal region	Average
1	Selection of Varieties	31.33	15.99	27.33	24.82
2	Selection of items and sett preparation	32.40	23.60	28.40	28.13
3	Land preparation and planting	16.66	19.33	13.33	13.11
4	Depth of planting	42.00	20.00	32.00	31.33
5	Spacing	24.00	14.00	22.00	20.00
6	Inter cropping	10.00	5.00	10.00	8.33
7	Application of FYM	44.00	39.00	42.00	41.16
8	Application of inorganic fertilizers	55.50	44.50	52.50	49.83
9	Weeding and inter-culturing	16.00	46.00	44.00	22.22
10	Cassava mosaic management	71.13	62.00	52.64	61.90
11	Time of harvesting	1.00	2.00	4.00	5.33
12	Storage of planting materials	48.00	47.00	41.00	45.33
	Overall average	36.97	29.62	33.26	31.61

CD between blocks (region) : 4.292

CD within regions : 14.867

CD between technologies : 6.069

4.4.1 Region wise Distribution of Respondents Based on Technology Gap

The analysis indicates that nearly 50 per cent (48%) of the respondents were coming under low category of technology gap. 33 per cent of the respondents occupying in very low group,15 per cent belonged to high group and it is observed that the negligible per cent (4%) respondents belonged to very high category.

Table 37 Region wise Distribution of Respondent Based on Technology Gap

Category	Hilly region		Midland region		Coastal region		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Very low(<-25)	13	26	20	40	17	34	50	33
Low (26-50)	20	40	28	56	23	46	71	48
High(51-75)	13	26	2	4	8	16	23	15
Very high(>75)	4	8	0	0	2	4	6	4
Total	50	100	50	100	50	100	150	100

4.4.2 Relationship of Technology Gap and the Profile Characteristics of the Respondents

The correlation analysis of the profile characteristics of respondents with the technology gap index (Table 38 and Fig. 7) revealed that, technology gap in the farming practices of the farmers had a significant but inverse association with many of this profile characteristics. Technology gap is found to be increasing with the age of the farmers (-0.1978*), the farm size (upland =-0.2814* and low land = -0.2885*), innovativeness (-0.1802*) leadership (-0.0597**) and market orientation (-0.2747*). How ever it is found that self confidence and economic motivation do play harm with the technology adoption behaviour of the farmers as the technology gap index shows positive significant correlation with self confidence (0.4154**) and economic motivation (0.3804**) score of farmers.

The most noticeable features of the correlation analysis is many of the profile characteristics which hither to have been believed to inducive to technology gap reduction are not found to be significant in the study. Education, knowledge, experience, scientific orientation, extension

contact, mass media exposure and social participation are the variables which showed no correlation with technology gap index of the farmers.

Table 38 Relationship of technology gap and the profile characteristics of the respondents

N=150

Sl No	Profile characteristics	Correction coefficient
1	Age	-0.1978*
2	Education	-0.1345
3	Experience	-0.0920
4	Area –Up land	-0.2814*
5	Area-Lowland	-0.2885*
6	Scientific orientation	-0.0826*
7	Extension contact	-0.0469
8	Economic motivation	0.3804**
9	Self confidence	0.4154**
10	Innovativeness	-0.1802*
11	Leadership	-0.0597**
12	Knowledge	-0.0871
13	Market orientation	-0.2747*
14	Mass media exposure	-0.1303
15	Social participation	-0.0144

* Significant at 5 % level

** significant at 1 % level

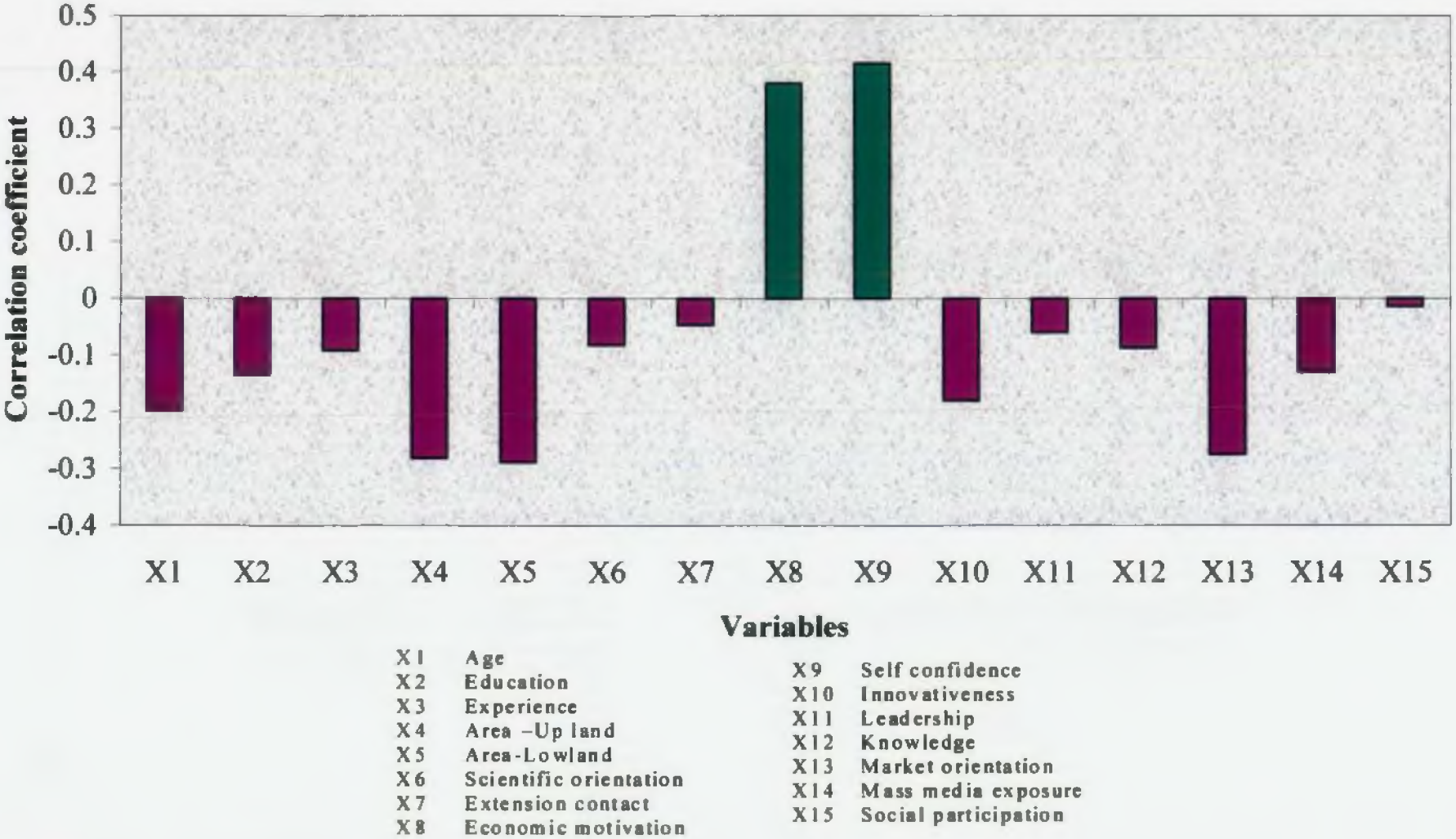


Fig. 7. Relationship of technology gap and the profile characteristics of the respondents

4.5 THE CONSTRAINTS IN THE CASSAVA CULTIVATION AS PERCEIVED BY FARMERS

It could be deciphered from the Table 39 and Fig. 8 that high wage rate was mentioned as the major constraint in cassava cultivation and reducing profit. The second important constraint was noticed as labour scarcity. The farm labourers were slowly moving to other occupation like industries due to guaranteed and high wages. Hence farmers face labour scarcity.

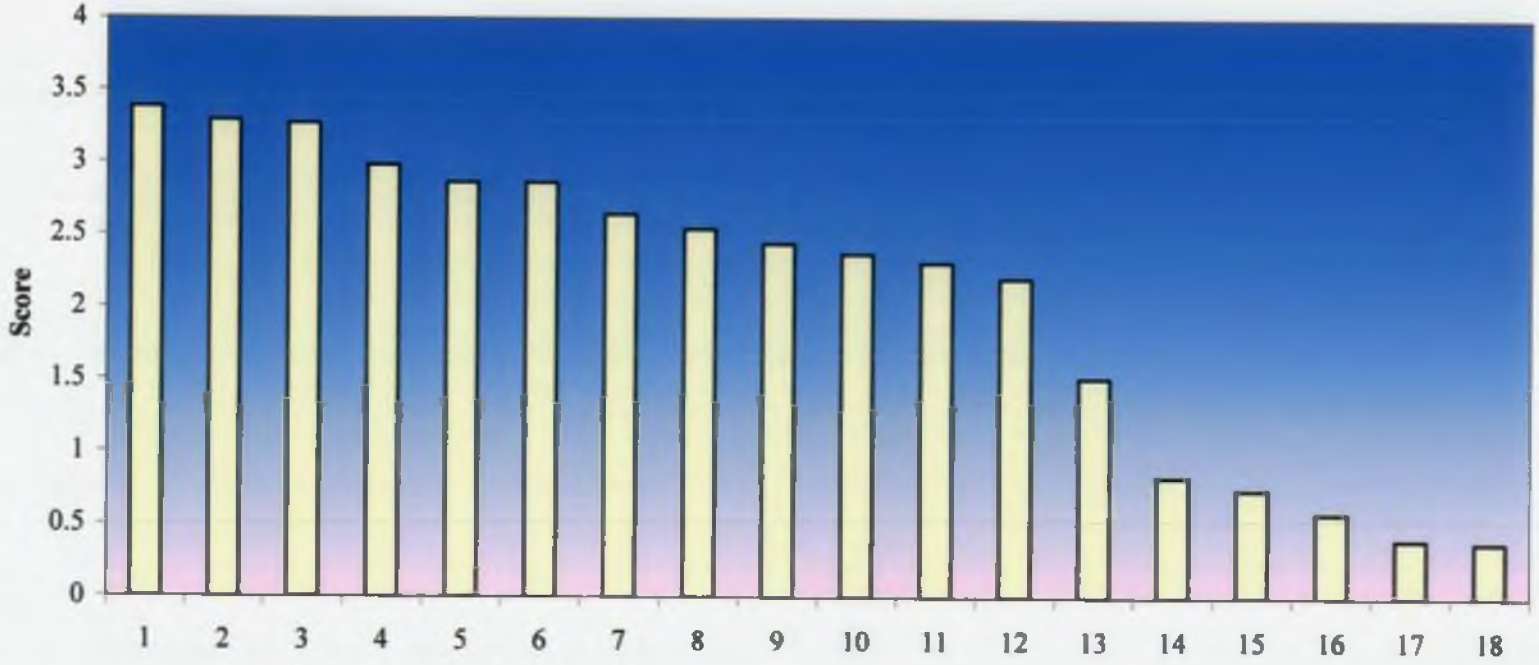
Water scarcity was mentioned as the third important constraint. The failure of monsoon, water table going down in summer season and absence of any alternate source of irrigation such as canal or tank irrigation could be other reason.

High cost of fertilizer was mentioned as the other major constraint. Majority of the respondents opined that every year the cost of fertilizer was getting increased not in proportion with the price of their produce.

Non-availability of good quality planting material was mentioned as the next most important constraint. In general farmers procured planting materials either from preceding crop or purchasing from neighbouring plots, knowingly or unknowingly the quality of setts. Quality can be measured in terms of productivity or its excellent nature of cooking quality. Farmers opined that the availability of excellent cooking quality with high yielding variety was still existing as a constraint.

It was found that rat menace was also hindering the cultivation of cassava. The nature of small holdings and provision for getting food to eat in non-crop season due to year round cultivation of crops might be existing the presence of rat in the field through out the year could be resulted as a major constraint.

Easy perishable nature of tuber was figured as seventh constraint in the statement of constraints list. Unless and otherwise to be sold the tubers or processed in a day or two the quality become deteriorated and resulted



1 High wage rate of agricultural labourers
2 Labour scarcity
3 Scarcity of water
4 High cost of fertilizer
5 Non-availability of good quality planting materials
6 Rat menace
7 Perishability of tubers
8 Non availability of inputs in time
9 Poor avenues for alternative use
10 Long duration of the crops
11 Lack of knowledge about relative advantages of HYM of cassava
12 Lack of traditional markets
13 Cassava mosaic disease
14 Uncertain market and fluctuation
15 Poor quality of inputs
16 Lack of producer organizations
17 Lack of knowledge about application of plant protection chemicals
18 Non-availability of plant protection equipments and agricultural implements

Fig. 8. Constraints in the cassava cultivation as perceived by farmers

the complete crop loss. This phenomena of tubers prevents farmers from large scale cultivation of cassava.

Non-availability of input in time was considered as another major constraint. Farmers brought setts for planting from neighbours and even they utilized the setts of the previous season crop as the seed material. So there was more chance for getting diseased and unhealthy setts. Information regarding the arrival and distribution of inputs in Krishibhavan were not properly reaching to the farmers. This could be the reason for non-availability of inputs in time.

Poor avenues for alternate use of cassava was mentioned as the other important constraint. The respondents mentioned that lack of training in value addition and inadequate quality for post harvest technologies or the absence of cassava based industries are restricting farmers from large scale cultivation.

Lack of knowledge about the relative advantage of high yielding varieties of cassava was an another important constraint mentioned by respondents. Due to inadequate extension services, the latest information regarding the benefits and technological aspects of new high yielding varieties were not reaching most of the farmers. Many of the respondents are unaware of increased productivity and short duration nature of high yielding varieties which could be raised twice an year on their holdings. That might be the reason for lesser adoption of high yielding varieties as compared to local varieties.

Long duration of crop also preventing the farmers from large scale cultivation. Most of the local varieties needs 10 to 12 months period. due to the lengthy duration of the crops, farmers switched on to other season bound crops like vegetables.

It could be seen from the table the problem of mosaic disease was listed 13th position in the list of statement of constraints. The severity of

the disease was noticed in many farmers fields and 20 to 30 percentage of yield reduction also reported by the concerned scientific community, however the farmers of study area were not much bothered the mosaic problem as a severe constraint.

This finding was inline with the finding of Arunkumar (2002).

High fluctuation of price and uncertain market was also identified as a constraint as listed 14th position in the 18 number constraint list. Fluctuation in price varied widely for cassava tubers before and after harvesting season. During post harvest period farmers getting lower price for their produce due to heavy arrival of the produce in the market and resulting fluctuation in price which would ultimately affect the income.

Lack of producer organisations, lack of traditional markets, lack of knowledge about the application of plant protection chemicals and non-availability of plant protection equipments are some of the other constraints mentioned with lesser importance.

This finding was in accordance with the finding of Santha *et al.* (1990).

Table 39. Constraints in the cassava cultivation as perceived by farmers

(n=150)

Sl. No.	Statements	Score	Rank
1	High wage rate of agricultural labourers	3.38	I
2	Labour scarcity	3.29	II
3	Scarcity of water	3.27	III
4	High cost of fertilizers	2.98	IV
5	Non-availability of good quality planting materials	2.86	V
6	Rat menace	2.86	VI

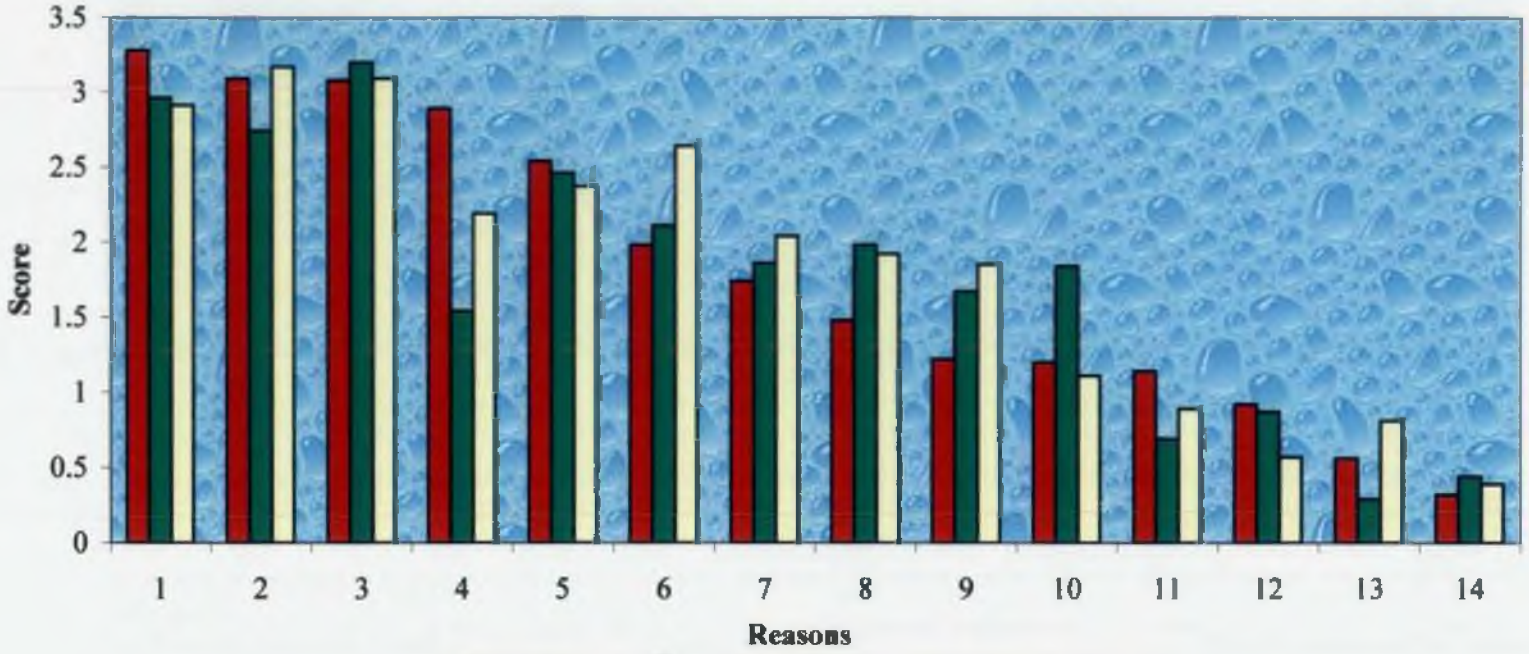
Table 39 Continued

Sl. No.	Statements	Score	Rank
7	Perishability of tubers	2.64	VII
8	Non availability of inputs in time	2.54	VIII
9	Poor avenues for alternative use	2.44	IX
10	Long duration of the crops	2.37	X
11	Lack of knowledge about relative advantages of HYM of cassava	2.31	XI
12	Lack of traditional markets	2.20	XII
13	Cassava mosaic disease	1.51	XIII
14	Uncertain market and fluctuation	0.83	XIV
15	Poor quality of inputs	0.74	XV
16	Lack of producer organizations	0.58	XVI
17	Lack of knowledge about application of plant protection chemicals	0.40	XVII
18	Non-availability of plant protection equipments and agricultural implements	0.38	XVIII

4.6 REASONS FOR THE DECLINE IN AREAS UNDER CASSAVA CULTIVATION

Reason for decline in area under cassava as ranked by respondents are given in Table 40 and Fig. 9. The following aspects were revealed from the ranking.

It has been observed that there is a considerable decline in the area of cassava in Kerala over last two decades. The cassava area has registered a negative growth rate to the tune of five per cent. The



1 Stiff competition from other remunerative crops
2 High wage rate of agricultural labourers
3 Conversion of land
4 Poor resource base of farmers
5 Lack of crop specific development programme
6 Rat menace and cassava mosaic disease
7 Weak technology transfer methods
8 Lack of traditional market
9 Lack of marketing support
10 Lack of industrial support
11 Influence of mass media and changes in the food habit
12 Lack of produce organizations
13 Bulkiness of planting material
14 Cassava is considered as soil depleting crop (it enhance soil erosion)

Fig. 9. Reasons for the decline in the area under cassava cultivation

present study reveals that the major factor contributing to this plight was stiff competition from the other major remunerative crops. The preference of farmers in favour of commercial and labour less intensive crops like rubber, coconut etc. leads the farmers to shift in cultivation.

High wage rate is found to be the second most important reason for decline area of cassava. This might be due to the high wage rate of Kerala labourers which is nearly four times greater than their counterparts of Tamil Nadu and Andhra Pradesh.

The third most important reason for decline in area was conversion of land. The classic case is the phenomenal growth in area of rubber even in small holdings. Similar is the case with coconut (especially in low land) which has displaced cassava area considerably. The drastic reduction in cassava might be due to the conversion of traditional cassava land for some other purposes like conversion meant for building purpose, consequent on the impact of urbanization.

Poor resource base of cassava farmers as figured was the other most important reason for decline in cassava area. Cassava farmers, majority of whom belongs to small and marginal category with poor resource base are neither organized nor have any forum or association to put forth their voice before the policy makers. This could have often resulted in low income to farmers who depend on cassava for their livelihood.

There is no well defined government development policy for enhancement of cassava cultivation, both at Central and State Government levels. Cassava in countries like Thailand and Indonesia receives due development support from government policy and finance wise.

Cassava mosaic disease continues to be a threat to the production and of late its spread has gained alarming proportion. It becomes a dreadful disease in local varieties and hybrids are no exceptions. This warrants a suitable solution of disease, resistant varieties or through abundant supply of disease free materials.

Weak technology transfer is concerned as another reason for decline in area under cassava cultivation. A differential pattern of adoption of technologies was observed with non-monitory practices. This necessitated the development of technologies appropriate to the clientele system to make necessary modification in the technology to enhance their adoption by the farming community.

The lack of marketing support is also identified as a reason for decline in area under cassava. There is no regulated system of marketing as far as cassava is concerned. Either farmer himself carry on the function of marketing where in harvesting is staggered over a long period or he sells his produce through contract system. In this situation, the effective price received by farmer is always less than what he gets by undertaking to retail himself.

Some of the other reasons which are rated as less relevance regarding decline in areas of cassava are lack of industrial support, influence in mass media and changes in the food habit, lack of producer organisations, bulkiness of planting materials, cassava is considered as soil depleting crop (it enhance soil erosion).

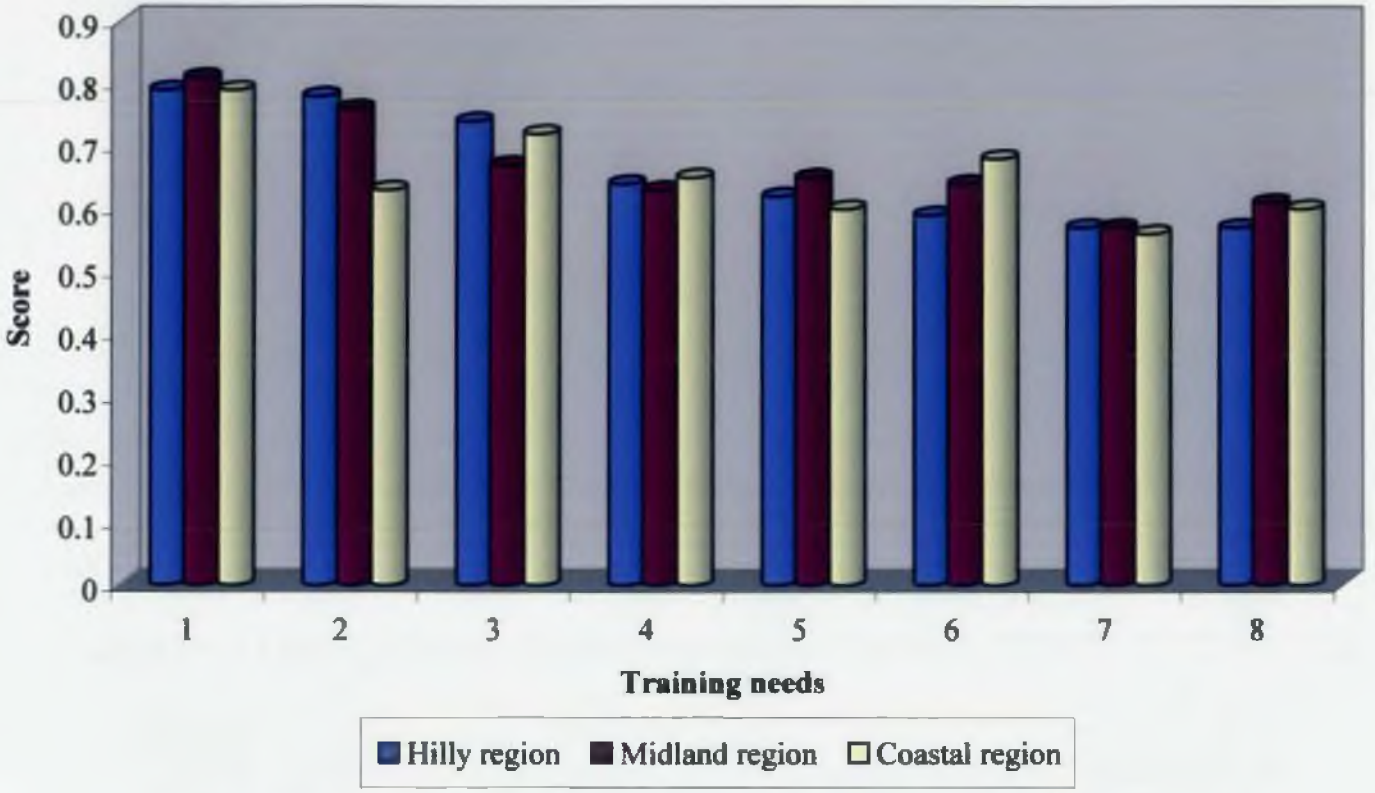
Rank order correlation worked out with the ranks obtained for all the three regions individually showed that the pattern of the perception on the reason on decline in cassava area has been similar in all the regions.

Table 40 Reasons for the decline in area under cassava cultivation

Sl. No.	Statements	Hilly region		Midland region		Coastal region	
		Mean score	Rank	Mean score	Rank	Mean score	Rank
1	Stiff competition from other remunerative crops	3.28	I	2.96	I	2.91	III
2	High wage rate of agricultural labourers	3.09	II	2.74	III	3.17	I
3	Conversion of land	3.08	III	3.20	I	3.09	II
4	Poor resource base of farmers	2.89	IV	1.54	VII	2.19	VI
5	Lack of crop specific development programmes	2.54	V	2.46	IV	2.37	V
6	Rat menace and cassava mosaic disease	1.98	VI	2.11	V	2.64	IV
7	Weak technology transfer methods	1.74	VII	1.86	VIII	2.04	VII
8	Lack of traditional market	1.48	VIII	1.98	VI	1.92	VIII
9	Lack of marketing support	1.22	IX	1.67	IX	1.85	IX
10	Lack of industrial support	1.20	X	1.84	X	1.11	X
11	Influence of mass media and changes in the food habits	1.14	XI	0.69	XII	0.89	XI
12	Lack of produce organizations	0.92	XII	0.87	XI	0.57	XIII
13	Bulkiness of planting material	0.56	XIII	0.29	XIV	0.81	XII
14	Cassava is considered as soil depleting crop (it enhances soil erosion)	0.32	XIV	0.44	XIII	0.39	XIV

4.7 TRAINING NEEDS OF FARMERS IN CASSAVA PRODUCTION AND PROCESSING

It can be seen from Table 41 and Fig. 10 that training needs of farmers in cassava production and processing in major subject matter areas in the order of preference were processing of cassava (value added products), harvesting, storage and marketing, preparation of planting



1 Processing of cassava (value added products)
2 Harvesting, storage and marketing
3 Preparation of planting materials and method of planting
4 Soil conservation measures for cassava
5 Manures and manuring
6 Plant protection
7 After cultivation (weeding and earthing up, irrigation, intercropping etc.)
8 Use of agricultural implements

Fig. 10. Training needs of farmers in cassava production and processing

materials and method of planting, soil conservation measures for cassava, manures and manuring, plant protection, after cultivation (weeding and earthing up, irrigated, intercropping etc., use of agricultural implements).

After having analysed the rank position of different subject matter areas, an attempt was also made to pin-point the major important areas as well as less important ones among these eight major subject matter areas. For this classification average mean score of the major subject matter areas was taken as the basis which was found to be 0.66 for hilly region and 0.67 for mid land region and 0.65 for coastal region. A major subject matter area with its mean score value greater than the average mean score was considered as more important whereas the one with a mean score value less than average mean score was treated as less important one. Based on this, processing of cassava (value added products) harvesting, storage and marketing, preparation of planting material and methods of planting happened to be the more important areas in that order of performance for hilly region.

In the case of midland region the mean score of the major subject matter areas was found to be 0.67. Based on this processing of cassava (value added products) harvesting, storage and marketing and preparation of planting materials and methods of planting emerged as the more important areas in that order of preference for midland region.

Regarding the coastal region the average mean score of the subject matter area was taken as the basis which was found to be 0.65. A major subject matter area with its mean score value greater than the average mean score was considered as more important one, whereas the one with a mean score value less than the average mean score was treated as less important one. The most important subject matter area of training in the order of preference were processing of cassava (value added products) harvesting, storage and marketing, preparation of planting material and method of planting and plant protection.

The analysis also reveals that most important first three subject matter of areas *i.e.* processing of cassava (value added products) harvesting, storage and marketing and preparation of planting material and method of planting.

Table 41 Training needs of farmers in cassava production and processing

Sl. No.	Major subject matter areas of training	Hilly region		Midland region		Coastal region	
		Mean score	Rank	Mean score	Rank	Mean score	Rank
1	Processing of cassava (value added products)	0.79	I	0.81	I	0.79	I
2	Harvesting, storage and marketing	0.78	II	0.76	II	0.63	III
3	Preparation of planting materials and method of planting	0.74	III	0.67	III	0.72	II
4	Soil conservation measures for cassava	0.64	IV	0.63	VI	0.65	IV
5	Manures and manuring	0.62	V	0.65	IV	0.60	VI
6	Plant protection	0.59	VI	0.64	V	0.68	V
7	After cultivation (weeding and earthing up, irrigation, intercropping etc.)	0.57	VII	0.57	VIII	0.56	VIII
8	Use of agricultural implements	0.57	VIII	0.61	VII	0.60	VII

Summary

5. SUMMARY

Cassava is an important root crop widely cultivated in tropical countries as a staple food. Cassava is a secondary crop extending primary function in the household economy of millions of weaker sections of the farming community in Kerala state. It enjoys the status of an industrial crop in the neighboring states of Tamil Nadu and Andhra Pradesh. It offers good scope for commercial exploitation in sago and starch industries.

The underlying intention of the study was to find out the cassava production system typology, technology gap and to analysis the technology utilization pattern of cassava farmers. The constraints in the cassava cultivation, the reason for the decline in the area under cassava and training needs of farmers in cassava production and processing were also studied.

The specific objectives of the study were,

1. To identify cassava production system typology
2. To find out technology gap.
3. To analyse the technology utilization pattern of cassava farmers.
4. To ascertain the constraints in the cassava cultivation.
5. To identify the reason for the decline in area under cassava.
6. To assess training needs of farmers in cassava production and processing.

The study was conducted at three blocks (Nedumangadu, Kilimanoor, Kazhakuttam) in Thiruvananthapuram district during from June to August 2004. Three block panchayats with highest area under cassava were selected one each from three region *i.e.*, hilly, midland and coastal regions. Similarly two grama panchayats from each of the selected

block panchayat having highest area under cassava were also selected Twenty five cassava farmers from each of the six panchayats were randomly selected as respondents. Thus a total 150 respondents were selected from six grama panchayats for the purpose of study.

Technology gap was selected as dependent variable .The profile characteristics of the respondents are the independent variables for the study.

The data were collected using pretested and structured interview schedule. The statistical tools used were frequency method, simple percentage analysis, correlation analysis and rank order correlation analysis.

The salient findings of the study are summarized below.

1. It was observed that 58 per cent of the respondents belonged to the old age group.36 per cent of the respondents were in the age group of 36 to 60 years (Middle age group) and only six per cent of respondents belonged to young age category. The study indicated that elders were shown more interest in cultivating cassava whereas youngsters had less affinity towards the cultivation. Nearly half of the respondents (49%) had education upto secondary level there were a negligible per cent (<2%) of illiterate farmers. Other major finding regarding the profile characteristics are 53 per cent of respondents had an experience in cassava cultivation found to have more than 25 years. Majority of the farmers (75%) possessed less than one acre of land, 43 per cent of farmers had medium level of scientific orientation, 46 per cent had medium level extension agency contact, 68 per cent had medium level economic motivation, 61 per cent had medium level self confidence and 49 per cent had medium level innovativeness, 60 per cent had medium level leadership, 54 per cent had possessed high level of knowledge, 53 per cent had medium level market orientation, 49 per

cent had medium level mass media exposure and 51 per cent had medium level social participation.

2. Seven type of production systems were identified based on type of land and type of cropping component. They are low land pure crop, upland pure crop, upland homestead, upland inter crop, lowland intercrop, upland mixed crop and lowland mixed crop. The findings also revealed that there was no lowland homestead.

3. The study revealed that majority of the area (28%) was being cultivated as lowland pure crop, followed by upland pure crop (21.54 per cent), upland homestead (18.64 per cent), upland inter crop (14.7 per cent), lowland inter crop (7.8 per cent), upland mixed crop (7.5 per cent) and lowland mixed crop (1.9 per cent).

4. The study also identified that 49 per cent of the total area was cultivated as pure crop, 23 per cent as an inter crop, 19 per cent as homestead and 9 per cent as mixed crop.

5. Under various production systems altogether 487 farms (fragments) were identified.

6. Majority of the respondents (43%) belonged to the category of commercial farmers followed by 34 per cent semi commercial and 23 per cent subsistence farmers.

7. It was observed that area under cassava cultivation was high in hilly region (37%) followed by midland region (30%) and coastal region (33%).

8. Regarding the production and productivity of cassava, though the total cultivated cassava area was observed more in hilly region (37%). The production of cassava found to be more in costal region (37%)the presence of loose fertile, friable sandy soil contributed to the increased production. Productivity also noticed higher in coastal region i.e., 18%. In hilly region it was noticed as 16% and midland region as 14%.

9. In the case of hybrid cassava varieties sree jaya occupied 3% area under hybrids followed by Sree Vijaya (26%) Sree Visakh (23%) and others (21%).

10. In the case of local varieties, M4 occuped 27% of the area under local variety followed by Kalian (11%), Ambalakadan (8%), Kasalachadi (7%), Sundatare vella (6%) and Kariyilaporian (6%) these are the major varieties. Some others localized varieties also cultivated in lesser proportion.

11. The interesting finding was that local variety M4 was the most suited varieties for majority of respondents due to its excellent cooking quality, better performance and wide range of adaptability. Some varieties which are predominant in certain localities are Njaruku and Ambakadan in midland region, Marvanis and Sundharivella in hilly region, Kariyilaporian and Kasalachadi in costal regions.

12. Total production of cassava was estimated as 805 tonnes by 150 respondents, with an average production of 5.36 tonnes per farmer.

13. Regarding the product utilization, it is estimated that 20 per cent of total production was being consumed as raw and 5 per cent consumed as processed, 57 per cent of the product was marketed as raw and 19 per cent marketed as processed.

14. Regarding ownership of land 78 per cent of cassava cultivation was in owned land, 22 percent was in leased land. It was also observed that lowland area was more preferred as leased land (15%) by the respondents, compared to upland area (7%)

15. Seventy nine per cent of respondents had selected varieties according to its use. 21 per cent of farmers do not select cassava variety according to its use.

16. Regarding the selection of stems and sett preparation 82 per cent of the respondents had followed recommended methods. 18 per cent of farmers did not follow recommended practices.

17. Nearly half of the respondents had fully adopted suitable land preparation methods as recommended. About 91 per cent of respondents followed the practice of mound method for planting cassava.

18. An overwhelming majority (94%) of the respondents had adopted vertical method of planting.

19. A fairly high proportion of respondents (68%) had fully adopted suitable planting depth as recommended (4-6 cm).

20. More than 50 per cent of the respondents (52%) had fully adopted recommended spacing for planting cassava.

21. It was observed that 80 per cent of the respondents had adopted the practice of inter cropping. Among the various inter crops amaranth was observed as the most preferred vegetable as an inter crop (31%) followed by cowpea (24%) amorphophallus (12%) colocasia (11%) ground nut (4%) and other vegetable (17%).

22. Sixty five per cent of the respondents had not applied FYM as recommended dose.

23. More than three fourth of the respondents (78%) followed the practice of applying inorganic fertilizers.

24. Fifty two per cent of the respondents had follow the recommended practice of weeding and earthing up. Among the 150 respondents only 4 per cent of them had used chemicals for weeding.

25. Regarding the mosaic management, 58 per cent of the respondents were least bothered about the use of disease free planting materials. 33 per cent of respondents had adopted the recommended resistant varieties *viz.* H-226, H-97 and H-165. Fifty two per cent of respondents had follow prompt disposal of cassava residue.

26. Eighty two per cent of the respondents harvested the tubers at the recommended time of harvesting.

27. Fifty seven percent of the respondents were least bothered about the storage of harvested setts.

28. The study revealed that there was disparity between technologies as well as regions. Hilly regions (37%) found to have experienced greater technology gap followed by coastal region (33%) and mid land region (30%) study on the technology gaps of different production technologies revealed that, the 'time of harvesting' was the most adopted technologies resulting in least technology gap (5%) followed by inter cropping (8%) and land was preparation and planting (13%). The wide technology gap was observed in technologies namely cassava mosaic management, application of inorganic fertilizer, storage of planting materials and application of farm yard manure which registered less popularity among the farmers with a higher average technology gap score of 62, 50, 45 and 41 respectively.

29. The high wage rate of agricultural labour was ranked as most severe production constraint experienced by the respondents. Labour scarcity was ranked as second important constraint followed by water scarcity, high cost of fertilizer, non-availability of good quality planting materials etc.

30. Regarding the reasons for decline in cassava area, it was observed that stiff competition from other major remunerative crops was found to be the most important factor contributing to this plight. High wage rate was found to be the second important reason for decline in cassava area. The other important reasons are conversion of land, poor resource base of cassava farmers, lack of crop specific development programmes, rat menace and cassava mosaic management etc.

31. The study indicated that respondents needed training in processing of cassava. The other subject matter areas of training needed are harvesting, storage and marketing, preparation of planting materials and methods of planting.

The wide range of technology gap is observed among cassava farmers due to the unorganized nature and poor resource base. In order to bridge the technology gap, detailed information on technology utilization pattern by cassava farmers is indispensable. Information on cassava technology utilization pattern and production system typology will indicate the significance of imparting training to the farmers, for which their training needs have to be ascertained. In production and processing of cassava several improved and advanced technologies have been generated. But there is a wide gap between available technologies and their adoption by farmers. In order to bridge this gap, framing appropriate development strategies for cassava, besides upgrading the technical competency of extension personnel is necessary. The detailed information on technology utilization pattern by cassava farmers is also indispensable for minimizing the technology gap. The identification of various production system typology will help to increase production and productivity of cassava.

Suggestions for Future Research

1. For generalization of findings, similar studies could be conducted in other districts also as the present study was confined to only one district
2. Similar studies may be conducted with respect to other crops like rice, fruits, medicinal and aromatic plants etc.
3. Content analysis of messages related to improved practices in cassava cultivation through print media and programmes in radio and television may be studied
4. Extension strategies of government and non government organizations for promotion of cassava cultivation may be studied for their efficiency.

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*Original not seen

Appendices

APPENDIX -I

Selection of variables for the study

KERALA AGRICULTURAL UNIVERSITY

College of Agriculture,
Vellayani, Thiruvananthapuram-695 522

Dr. A. Anilkumar
Assistant Professor

Department of Agricultural Extension
Date: 4.04.2004

Sir / Madam

Sub:- P.G. Education – Thesis Research Project – Judges opinion requested – regarding

Sri. V.R. Sasankan M.Sc(Ag.) student of this department has taken up a research study entitled "**Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district**". After extensive review of the available literature and discussions with extension scientists, variables supposed to have close association with the technology utilization of cassava have been identified.

For this purpose the student has listed out a number of personal, social, psychological and economic variables which may be useful for the study.

So I request you to kindly spare some part of the time from your busy schedule to rate the listed variables by putting a tick mark (✓) in the appropriate column.

Thanking you

Yours faithfully,

A. Anilkumar

Objectives of the study

- To find out the cassava production system typology and technology gap
- To analyse the technology utilization pattern of cassava farmers
- To identify the constraints in the cassava cultivation
- The reason for decline in the area under cassava
- Training needs of farmers in cassava production and processing

Sl. No	Variables	Most relevant	Relevant	Least relevant
1	**Age:** refers to the number of completed years of the respondent since birth.			
2	**Caste:** the caste hierarchy of respondents whether belongs to upper / backward/ scheduled caste.			
3	**Education:** defined as the formal schooling attended by the respondents.			
4	Income: refers to earnings of the family from all sources.			
5	**Farm size:** the total areas of the cultivated land possessed by the farmers at the time of conducting the survey.			
6	**Farming experience:** number of completed years experience in cassava farming.			
7	**Family size:** the number of members in the family living together.			
8	**Knowledge:** refers to the extent of information one has improved method of cassava cultivation.			
9	**Extension contact:** refers to the degree to which one has contact with different extension agencies.			
10	**Extension participation:** refers to the frequency of participation in various extension activities.			
11	**Mass media participation:** refers to the frequency with which different mass media are utilized by the respondents for getting information.			

12	**Social participation:** refers to degree of the respondents involvement in. formal and informal social organizations either as a member or as office bearer which also include their extent of participation in organizational activities.			
13	**Economic motivation:** refers to the extent to which a person is oriented towards profit maximization and relative value one places on monetary gains.			
14	**Achievement motivation:** refers to the striving of the respondent to do good work and attain as sense of accomplishment.			
15	**Cosmopoliteness:** refers to the tendency of the respondents to be in contact with outside village on the belief that all the needs of an individual can not be satisfied in their own village			
16	**Scientific orientation:** degree to which the respondent is oriented to the use of scientific methods in decision making			
17	**Innovativeness:** refers to the characteristics of the person to accept new ideas in farming			
18	**Level of aspiration:** refers to respondents orientation towards his life goal.			
19	**Indebtedness:** refers to the total debt in terms of money as respondent owes to various money lending sources such as private money lenders, relatives, co-operative etc			
20	**Self confidence:** belief of the respondent in his own abilities, initiative and resourcefulness to achieve his goal or aim.			
21	**Main occupation:** refers to the occupation from which a respondent receives maximum income.			
22	**Annual income:** Defined as the total earning of the farmer and the members of the family in a year from the farm and other sources in rupees			
23	**Area under cassava cultivation:** refers to the total areas under cassava cultivation measured in cents.			
24	**Market orientation:** defined as the degree to which a farmer is oriented towards the market in terms of the demand and price of his produce			

25	**Credit orientation:** refers to the favourable and positive attitude of a cassava grower towards obtaining credit from institutional sources			
26	**Leadership:** it is defined as the ability of a person to influence people to cooperate in achieving his goal			
27	**Achievement motivation:** refers to the Striving of farmer to do good work and attain a sense of accomplishment			
28	**Irrigation index:** It is the degree to which the cassava crops are being irrigated			
29	**Employment generation:** refers to the extent to which the farmer obtains additional employment opportunities			
30	**Availability of farm inputs:** refers to the availability of inputs to the farmer either from his own possession or by hiring it			
31	**Other variables, if any please specify and explain**			

Name :

Signature :

Designation :

APPENDIX - II

Selection of improved practices in cassava cultivation

KERALA AGRICULTURAL UNIVERSITY
College of Agriculture, Vellayani
Thiruvananthapuram-695 522

Dr. A. Anilkumar
Assistant Professor

Department of Agricultural Extension
Dated:27-05-2004

Sir / Madam,

Sub:- M.Sc.(Ag.) Research Project of Sri. Sasankan, V.R – Judges opinion requested – regarding

One of my P.G. students **Sri. V.R. Sasankan** has taken up a research project entitled " Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district". As a part of the research work, the student researcher likes to study the technology utilization in cassava production.

For this purpose he has listed out a number of improved practices in the production system of cassava. In order to assess the relevancy of the practices, they are to be rated on a three-point continuum (most important, important, least important).

With your experience and expertise in cassava cultivation, I consider you as one of the most appropriate judges to rate the various practices in cassava production according to their relevancy.

I request you to kindly spare some time for rating the practices.

Thanking you,

Yours sincerely,

(Dr. A. Anilkumar)

Please put tick (√) in the appropriate column against each practice keeping view the possible contribution of each practices towards production system typology and technology utilization pattern of Cassava.

Sl No	Practices	Most Important	Important	Least Important
1	Selection of Varieties			
2	Selection of stems			
3	Setts treatment			
4	Land preparation			
5	Planting method			
6	Quality planting material production			
7	Depth of Planting			
8	Spacing			
9	Time of planting			
10	Planting in sloppy land			
11	Planting in low land			
12	Inter cropping ground nut, cowpea etc			
13	Cassava as intercrop in perennials			
14	Earthing up			
15	Application of FYM			
16	Application of inorganic fertilizers			
17	Application of micro nutrients			
18	Crop rotation			
19	Weed management			
20	Irrigation management			
21	Whitefly management			
22	Scale management			
23	Mosaic management			
24	Tuber rot management			
25	Die back management			
26	Leaf spot management			
27	Harvesting technology			
28	Time of Harvesting			
29	Storage of planting materials			

Name :
Designation :
Signature :

APPENDIX - III

Selection of constraints for the study

KERALA AGRICULTURAL UNIVERSITY
College of Agriculture, Vellayani
Thiruvananthapuram-695 522

Dr. A. Anilkumar
Assistant Professor

Department of Agricultural Extension
Dated:09-06-2004

Dear sir,

Sri. V.R. Sasankan M.Sc(Ag.) student of this department has taken up a research study entitled "Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district" under my guidance he has identified 17 main constraints faced by farmers in cassava cultivation based on review of literature, discussion with experts and pilot study 17 statements related to the production constraints of cassava are also given. Please consider the statements regarding suggestions for improving production system.

Considering your past experience, I request you to offer your valuable rating about the extent of agreement or disagreement for the statements given. Please put a tick mark in the appropriate column. Kindly give suggestions also to make the study more meaningful and effective.

With regards,

Yours faithfully

(Dr. A. Anilkumar)

Constraints in the cassava cultivation as perceived by farmers

Sl. No.	Constraints	VS	S	UD	NS	NAS
1	Labour scarcity by farmers					
2	Timely availability of inputs					
3	Non availability of good quality planting materials					
4	High cost of fertilizers					
5	Lack of knowledge about application of plant protection chemicals					
6	Scarcity of water					
7	Non-availability of plant protection equipments and agricultural implements					
8	Poor quality of inputs					
9	Perishability of tubers					
10	Lacks of knowledge about relative advantage of HYV of cassava					
11	Long duration of the crops					
12	Rat menace and mosaic disease					
13	Lack of producer organizations					
14	Lack of traditional markets					
15	High wage rate of agricultural labourers					
16	Poor avenues for alternative use					
17	Uncertain market and fluctuation					
18	Others, if any					

VS Very severe

S Severe

UD Undecided

NS Not severe

NAS Not at all severe

APPENDIX - IV

Selection of reasons for decline in area under cassava cultivation

KERALA AGRICULTURAL UNIVERSITY
College of Agriculture, Vellayani
Thiruvananthapuram-695 522

Dr. A. Anilkumar
Assistant Professor

Department of Agricultural Extension
Dated:09-06-2004

Dear sir,

Sri. V.R. Sasankan M.Sc(Ag.) student of this department has taken up a research study entitled "Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district" under my guidance he has identified 14 reasons for decline in cassava area based on review of literature, discussion with experts and pilot study. Please consider the statements regarding suggestions for improving production system.

Considering your past experience, I request you to offer yours valuable rating about the extent of agreement or disagreement for the statements given. Please put as tick mark in the appropriate column. Kindly give suggestions also to make the study more meaningful and effective.

With regards,

Yours faithfully

(Dr. A. Anilkumar)

Reason for decline in cassava area

Sl. No.	Reasons	SA	A	UA	DA	SDA
1	Conversion of land					
2	Poor resource base of farmers					
3	Bulkness of planting material					
4	Stiff competition from other remunerative crops					
5	Influence of mass media and changes in the food habit					
6	Lack of industrial support					
7	Lack of crop specific developed programme					
8	Lack of marketing support					
9	Cassava is considered as soil depleting crop (it enhances soil erosion)					
10	Rat menace and cassava mosaic disease					
11	Lack of traditional market					
12	High wage rate of agricultural labourers					
13	Weak technology transfer methods.					
14	Lack of producer organizations					
15.	Others, if any					

SA-Strongly agree A-Agree UD-Undecided DA-Disagree
SDA-Strongly disagree

Training needs of farmers in cassava production and processing

Sl. No.	Major subject matter areas for training	Need of training		
		Much need	Some what needed	Not needed
1	Preparation of planting materials and method of planting			
2	Soil conservation measures for cassava			
3	Manures and manuring			
4	After cultivation (weeding and earthing up, irrigation intercropping etc)			
5	Plant protection			
6	Use of agricultural implements			
7	Harvesting storage and marketing			
8	Processing of cassava (value added products)			

APPENDIX – V

Interview Schedule

Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district

Date :

Panchayat :

Ward :

Respondent No :

1. Name of the respondent :

2. Address :

3.Age in completed years :

4. Educational status

Category
Illiterate
Primary school level
Secondary school level
Collegiate

5.Experience in cassava cultivation (years) :

6. Mass media exposure

Sl . No	Mass media	Regularly	Occasionally	Never
1.	Radio			
2.	Newspaper			
3.	Television			
4.	Magazine			
5.	Internet			
6.	Books			
7.	Other literature on agriculture			
8.	Others			

7.Area under cassava cultivation

Sl. No.	Category	Area (acre)
1	Rainfed	
2	Irrigated	
3	Total	

8. Scientific orientation

Sl. No.	Statements	SA	A	UD	DA	SDA
1	New methods of farming give better results than the old methods					
2	The way of farming by our fore fathers is the best way of farming today					
3	Even the farmers with a lot of farming experience should use new method of farming					
4	A good farmer experiments with new ideas of farming					
5	Though it takes time for a farmer to learn new methods in farming it is worth the efforts					
6	Traditional methods of farming have to be changed in order to raise the living of a farmer					

9. Contact with extension agency

Sl No.	Category of personnel	Frequency of Contact		
		Regularly	Occasionally	Never
1	Agricultural Assistants			
2	Agricultural Officers			
3	Agricultural Scientists			
4	Extension functionaries of NGO's			
5	Others			

10.Economic Motivation

Sl No.	Statements	SA	A	UD	DA	SDA
1	A farmer should work towards larger yield and economic returns					
2	The most successful farmer is one who makes the highest profit					
3	A farmer should try any new farming ideas which may earn him more money					
4	A farmer should grow cassava crop in addition to other crops in order to increase his monitory profit.					
5	It is difficult for the farmer's children to make a good start unless he provides them with economic assistance.					
6	A farmer must earn his living but the most important thing in life cannot be defined in economic terms.					

11.Self Confidence

Sl No.	Statement	SA	A	UD	DA	SDA
1	I feel no obstacle can stop me from achieving my final goals.					
2	I am generally confident of my ability					
3	I am bothered by the inferiority feeling that I cannot compete with others					
4	I am not interesting to do things own my own initiative					
5	I usually work out thing for myself rather than depending others					
6	I get encouraged easily					
7	Life is a struggle for me most of the times					
8	I find myself worrying about something or the other, most of the time					

12.Social Participation

R-Regularly ST-sometimes N-Never

Sl No.	Organisation	Name of participation		Frequency of participation to meetings/ activities		
		Member	Office bearer	R	ST	N
1	Karshika vikasana samithies / other vikasana samithies of Krishi Bhavan					
2	Co-Operative Society					
3	Farmers / youth club					
4	Farmers organization (Trade union)					
5	Political party					
6	Others (specify)					

13. Leadership quality

Sl. No.	Statements	Always	Some times	Never
1	Do you think you can change the attitude of others			
2	Do you guide and influence the behaviour of others in taking decisions			
3	Do you lead meetings and discussions			
4	Do you feel others are convinced by you			
5	Are you available to others at any time to extend necessary help to them			
6.	Do you identify the social problems and take it up with others for resolving			

14. Innovativeness

When would you like to adopt improved cassava cultivation practice ?

Sl. No.	Response	Score
1	As soon as it is brought to my knowledge	3
2	After I had seen other farmers tried successfully in the farm	2
3	I prefer to wait and take my own time	1
4	I am not interested in adopting improved cassava cultivation practices	0

15. Knowledge

Please tick mark (✓) the correct answer from the choice given below :

a. Name the type of groundnut suitable for intercropping in Cassava.
(a) Spreading type ( ) (b)Bunchy type ( ) (c) Semi –Spreading type ( )

b. Quantity of compost required for one ha of cassava is
(a) 12.5 t ( ) (b) 30 t ( ) (c) 5 t ( )

c. The ideal thickness of the cassava stem used for planting is :
(a) 1 cm ( ) (b)5.5 cm ( ) (c)2.5 cm( )

d. The length of setts suitable for planting is :
(a) 5 cm ( ) (b) 15 - 20 cm ( ) (c) 25-30 cm( )

e. Number of setts to be planted on a single mound is :
(a) Four ( ) (b) two ( ) (c) One ( )

f. Name the most important method of planting the setts.
(a) horizontally ( ) (b) vertically ( ) (c) in slanting position ( )

g. Ground nut seeds are to be dibbled:
(a) Along with planting cassava ( ) (b) one week after planting Cassava( )
(c) One month after planting cassava ( )

h. Number of shoots to be retained in cassava plant is
(a) one ( ) (b) two ( ) (c) three ( )

i. Quantity of potash needed for one hectare of cassava:
(a) 50 kgs ( ) (b)100kg ( ) (c) 150 kgs ( )

j. Identify the nutrient to be applied in full dose as basal application
(a) potash ( ) (b) Urea ( ) (c) Mussoriephos ( )

k. Name the important disease of cassava:
(a) wilt ( ) (b) leaf spot ( ) (c) mosaic ( )

l. The cassava mosaic disease is controlled:
(a) By paint marking the diseased plants and not using the same as planting material after harvest ( ) (b) by spraying fungicide ( )
(c) by destroying diseased plants ( )

16. Market orientation

a) Do you adopt a marketing strategy in which the buyers have been appropriately selected from categories such as intermediaries, sellers or the ultimate consumer in such a way as to get maximum price.
Always / Sometimes / Never

b) Is it possible for a farmer to get reasonably good price if he cultivate cassava compared to other crop?

Yes / No

c) Do you think the selection of cassava varieties that suits consumer demand is necessary for getting good price?

Yes / No

d) How do you feel about the saleability of cassava?

Very difficult / Difficult / Easy

17.Constraints in the cassava cultivation as perceived by farmers

Sl No.	Constraints	Most Important	Important	Least Important
1	Lack of sufficient good quality planting materials			
2	Non-availability of inputs in time			
3	Exclusive prevalence of pest and diseases			
4.	Lack of awareness and knowledge about high yielding variety of cassava			
5	High cost of inputs.			
6	Labour scarcity.			
7	Inadequate research and extension support			
8	Inadequate information about improved cassava cultivation.			
9	Lack of credit facilities			
10	High labour charges			
11	Inadequacy of capital			
12	High transport charges			
13	Lack of marketing facilities			
14	High perishable nature of cassava tubers			
15	Lack of storage facility			

PRODUCTION SYSTEM TYPOLOGY

A. Total area under cassava

No.	Particulars	Total area, ha	Leased in	Owned	Production, kg	Mono-crop	Inter-crop	Mixed crop	Homestead
1	Lowland								
2	Upland								
	Total								

In homestead mention the name of crop including cassava and indicate the proportion of land utilized.

Name of Crop	Proportion of land utilized, %
1.	
2.	
3.	
4.	

B Kindly indicate the following category to which the farmer belongs on the basis of cropping objective. (If a farmer sells more than 60 per cent of his produce he is include in the category of commercial farmer, between 20-60 %-semi commercial, less than 20 % -subsistence farmer)

Commercial	Semi commercial	Subsistence

C. Product utilization

Total production, kg	Used, kg		Marketed, kg	
	Raw	Processed	Raw	Processed

TECHNOLOGY UTILIZATION PATTERN

A. Selection of variety

Varieties	Cassava cultivated area (acre)		
	Low land	Upland	
		Homestead	Others
Local			
1			
2			
3			
Hybrid			
1			
2			
3			

B. Selection of stems

i. Whether setts have been selected from matured healthy stems ? Yes / No
ii. Whether the stems having 2 – 3 diameter have been selected ? Yes / No.
iii.While selecting setts do you discard the woody basal portion and tender top portion of the stems ? Yes / No
iv.Are you following the recommended standard size of setts (ie., 15-20 cm length) in selecting setts? Yes / No
v.Do you prepare setts with a smooth circular cut ? Yes / No

C. Land preparation and planting

i. Kindly indicate whether you have adopted suitable methods of land preparation methods as recommended – Fully / Partially / Not at all
ii. Indicate which method of land preparation you are generally following
a. Ridge method b. Mound method c. Flat bed method d. Pit method

Methods	Low land	Upland	
		Homestead	Others
Mound			
Ridge			
Flat bed			
Pit			

Kindly indicate dimension (Size, diameter, height etc)
iii. Which one of the planting method you are generally following
a. Vertical b. Horizontal c. Slanting

Low land	Upland	
	Homestead	Others

D. Depth of planting

(Please indicate whether you have adopted suitable planting depth as recommended ie., 4-6 cm) Yes / No

If no, mention the actual depth of planting :

E. Spacing

Are you following the recommended spacing (ie., 90 x 90 cm spacing If no, what is the actual spacing followed?

For branching / semi branching type and 75 x 75 cm for non branching / erect branching type) – Yes / No.

Branching nature of the crop : Branching or Semibranching or Non branching or Erect.

F. Intercropping

i. Do you cultivate intercrops in the cassava crop ? Yes / No

ii.If Yes, mention the name of crops and varieties

Name of crop	Varieties
1. 2. 3.	

iii. Whether you are planting intercrops immediately after planting cassava ?

Yes / No

G. Application of FYM

(Please indicate whether you are applying FYM as recommended (ie., 12.5 tonnes / ha).

As per recommendation / More than or less than recommended dose / No at all

Actual quantity of FYM applied per ha.

H. Application of inorganic fertilizer

i. Do you apply fertilizer like urea, MOP and Mussoriephos ? Yes / No

ii.If Yes, whether you are applying entire mussoriephos, half of urea and MOP recommended as basal and remaining urea and MOP for topdressing. ?

Strictly as recommended / Partially / Not at all

iii. Are you applying the fertilizer at the appropriate stages of the crop as recommended – Yes / No

Strictly as recommended / Partially / Not at all

iv. Application of fertilizer

Name of fertilizer	Quantity	Stages of application
1. 2. 3.		

I. Weeding and earthing up

i.Please indicate whether you are following the practices of weeding and earthing up as recommended – Yes / No

ii.If yes how many times the operation of weeding and earthing up are resorted to_____ (recommended 1MAP, 2 MAP).

iii. Kindly indicate which method of weeding you are generally following /

a. Handweeding b. Chemical weeding c. Both

Name of the chemical	Quantity used
1.	
2.	
3.	

J. Cassava mosaic management

Please indicate whether you are adopting below mentioned practices for controlling cassava mosaic disease

i. Using disease free planting material. Yes / No

ii. Growing field tolerant varieties like H-97, H-165. Yes / No

iii. Rogue out the infected plants and follow strict field sanitation measures. Yes / No

iv. Keep the field free of self sown cassava plant which may serve as a source of inoculum and help the spread of disease. Yes / No.

v. Prompt disposal of cassava residue Yes / No

vi. Spray insecticide like Roger dimacrone etc Yes / No

vii. Besides the above recommended practices what are the methods do you adopt for controlling the mosaic disease?

K. Time of harvesting

Are you harvesting cassava at the correct maturity stage ? Yes / No

L. Storage of planting material

Please indicate whether you are keeping your stems in thatched shed or any proper storage devices – Yes / No

While storing do you keep the stems in upright positions – Yes / No

PRODUCTION SYSTEM TYPOLOGY AND TECHNOLOGY UTILIZATION PATTERN IN CASSAVA CULTIVATION IN THIRUVANANTHAPURAM DISTRICT

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ABSTRACT

The study entitled "Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district" was undertaken to identify the cassava production system typology, analyse the technology utilization pattern of cassava farmers, assess technology gap and ascertain the constraints in the cassava cultivation, to identify the reason for decline in area under cassava and to access training needs of farmers in cassava production and processing.

A sample of 150 farmers were selected at random from six Grama panchayat from three block panchayat of Thiruvananthapuram district. In addition to this 50 respondents to comprising scientists working on cassava, extension functionaries, cassava sellers and consumers were selected for identifying reasons for decline in area under cassava cultivation.

The data were collected using pre-tested and well structured interview schedule. The study showed that elders had shown more interest in cassava cultivation compared to youngsters.

Based on type of land and type of cropping component, seven types of production systems were identified. Among the seven production systems, low land pure crop (28 %) constitute the major production system followed by upland pure crop (21.54 %). The study also revealed that 49 per cent of the total area was cultivated as pure crop followed by intercropping (23 %) and the percentage share of homestead and mixed cropping were 19 and 9 per cent respectively.

Majority of the respondents (43 %) belonged to the category of commercial farmers followed by (34 %) semi-commercial and 23 per cent subsistence farmers.

The study on technology gap revealed that there existed disparity between technologies as well as regions. Hilly regions found to have

greater technology gap (37 %) followed by coastal region (33 %) and midland region (30 %). Wide technology gap was observed in technology namely cassava mosaic management, application of inorganic fertilizers and storage of planting materials.

Regarding the production constraints faced by the farmers, it was observed that high wage rate of agricultural labourers was ranked as the most severe constraint followed by labour and water scarcity.

Study on reasons for decline in area under cassava cultivation showed that stiff competition from other major remunerative crops as the most important reason. High wage rate of agricultural labourers and conversion of land were the other important reasons for the decline in area under cassava cultivation.

The study revealed that processing of cassava was the most important area of training needed by the respondents.

The wide range of technology gap is observed among cassava farmers due to the unorganized nature and poor resource base. In order to bridge the technology gap, detailed information on technology utilization pattern by cassava farmers is indispensable. Information on cassava technology utilization pattern and production system typology will indicate the significance of imparting training to the farmers, for which their training needs have to be ascertained. In production and processing of cassava several improved and advanced technologies have been generated. But there is a wide gap between available technologies and their adoption by farmers. In order to bridge this gap, framing appropriate development strategies for cassava, besides upgrading the technical competency of extension personnel is necessary. The detailed information on technology utilization pattern by cassava farmers is also indispensable for minimizing the technology gap. The identification of various production system typology will help to increase production and productivity of cassava.