MECHANIZATION NEEDS OF SUGARCANE GROWERS IN BELGAUM DISTRICT

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1. INTRODUCTION

Agriculture contributes about 14.20 per cent to GDP and livelihood for 58.40 per cent of Indian population. India is blessed with traditional wisdom, knowledge, skills and crafts to practice agriculture. However, other inputs including agricultural engineering technologies are gaining importance for increasing production, productivity and cost competitiveness. Mechanization in agriculture is predominantly taking place mainly for operations where traditional practices have failed to achieve the precision in operations. This is mainly due to the fact that agricultural labour available in Indian farms is becoming scarce day by day due to rapid industrialization, urbanization, migration and employment guarantee programmes. Quantity as well as quality of daily work output of agricultural labourers is also decreasing (Duraisamy, 1998).

Agricultural machines have now been recognized as one of the major inputs in agriculture due to the advantages such as reduction in operational costs, minimizing human drudgery in addition to increasing farm production. Farm machines also confer definite benefits to the farmers in terms of greater efficiency, economy and higher productivity particularly by speeding up agricultural operations during crucial periods. Studies have revealed that farm mechanization has led to an increase in the productivity of land by as much as 30.00 per cent (Rangasamy *et al,* 2002)

Mechanization in Indian agriculture has picked up momentum with the production of tractors and power tillers since 1960. The utilization level of tractors in India for agriculture is just 17 tractors per 1000 ha of available land as against 256 in Japan. However, the growth rate is 4 to 5 per cent per annum. The growth rate in other farm machinery and equipments is also showing higher growth trend. Forty per cent increase in demand of combine harvesters is seen in last three years. The growth rate of rotavetor is 50.00 per cent per annum , for drip irrigation 25.00 per cent per annum, and 10.00 per cent each in power tillers, threshers and power sprayers. The power available in Indian farms which was 0.43 hp per ha during the last decade has increased to more than 1.45 hp per ha (Anonymous,2011). However, the power availability in the Indian farms needs to be raised by 2.50 times to cope up with the power available in the farm lands of developed nations for achieving maximum farm mechanization and crop yield (Rangasamy *et al.,* 2002).

The average per capita operational size of land holding in India is 1.33 ha, which is far below the world average of 3.70 ha per person. Further, land holdings have shown a marginal decrease from the holding size of that of a decade ago. Over 80% of the land holdings in India are classified as small and marginal land holdings with the farm size of less than 2.00 ha. This implies that over 80.00% of the farmers in India hold just 39% of the total cultivated land. Hence development of farm machinery and implements which are in line with the needs of the farmers can cause a greater headway towards the development of agriculture. Since the size of the holdings in India is smaller, it is necessary for designing new agricultural equipments and machinery to suit the available farm power and improve the existing farm machinery and implements to suit the local conditions and enable the farmers to do the farm operations better and faster.

In India three major levels of mechanization technologies can be observed viz., hand tool technology with human labor as main power, animal drawn or draft technology with animals as main source of power and mechanical power technology using internal combustion and electrical power (Rijk, 1986).

Mechanization technologies, irrespective of their levels contribute to the positive social change. However, many constraints are faced by the farmers like high initial investment and maintenance cost, high fuel cost, small and fragmented holdings and non availability of suitable farm machinery.

Sugarcane is an important agro-industrial crop in India which plays a pivotal role in national economy by contributing 1.90 per cent to GDP. The crop is cultivated in 4.22 m ha producing 300 mt with a productivity of 75 to 80 t/ha. However, there have been fluctuations in area as well as productivity over the years on account of several factors. Generally sugar and gur (jaggery) are prepared from sugarcane.

Sugarcane is one of the crop in which there has been little mechanization in India, except for the initial land preparation carried out using conventional farm machinery, the rest of the operations from planting to harvesting, employ manual methods either using family labour or hired labour (Dharmawardene and Krishnamurthi, 1992). Analysis of cost of production of sugarcane in these small farms shows that highest cost component is for sugarcane harvesting and loading followed by land preparation, planting, weeding, fertilizer application and irrigation. Most of these operations when carried out manually are labour intensive, time consuming and tiresome. As a result, these often get neglected due to non availability of labour for such heavy manual works. Furthermore, small farmers find it difficult to complete a given task within a specified period of time which affects both the sugarcane yields and its quality (Dharmawardene, 2006). It is often observed that productivity of manual workers decrease quickly within a few hours of working in the hot tropical sun, who then resorts to taking short breaks for rest leading to disruption of work (Dharmawardene and Krishnamurthi, 1992). Thus, in manual cultivation of sugarcane, much of the recommended practices such as timely weeding, fertilizer application, earthing up, detrashing, stubble removing, etc., are neglected leading to poor stand of both in main crop and ratoon cane especially when hired labour is used.

Considering the importance attached to the farm machinery and implements, studies on various aspects of these have been taken up in the past. But most of the studies are confined only to types of farm machinery and implements possessed and extent of their use by the farmers and totally neglecting the needs of farm machinery and equipments of the farmers.

Therefore, there is a need to have such studies which through light on needs of farm mechanization. Keeping the above facts in the mind the present research study was designed with the following objectives.

Objectives of the study:

1. To document the status of mechanization in sugarcane cultivation.
2. To identify the gaps in knowledge and adoption of improved farm equipments in sugarcane cultivation.
3. To document the constraints in use of farm equipments.
4. To map the mechanization needs of sugarcane growers.

Special Features of the Study

The study helps to document the status of the sugarcane farmers regarding the extent of mechanization and will identify the gaps in knowledge and adoption of improved farm machinery and equipments. The study will also focus on the problems faced by sugarcane growers in using farm machinery and equipments designed so far. In this way the present study would be helpful to prioritize the needs for mechanization in sugarcane. The findings will help agricultural engineers to develop suitable farm machinery and equipments for sugarcane cultivation.

Limitations of the Study

The study had the limitations of time which a student researcher would normally encounter. Yet, sincere and thoughtful attention was put forth to make this study an objective, definite and systematic one. Despite the limitation, best efforts were extended to make the study, a quality one.

2. REVIEW OF LITERATURE

Review of relevant literature is an essential part of the research, which helps the research worker to tune up his efforts in the right direction for further probe in the matter. This chapter deals with past research done related to the subject of the present study. The topic was new and relatively untouched by the researchers. The author could not locate the past studies in more number having direct bearing on the topic under investigation. Efforts were made to review number of reports, periodicals and theses having direct, indirect or derived relationship with the present investigation. Review of research is presented in the following sequence.

2.1 Profile of the sugarcane growers

2.2 Status of farm machinery and equipments

2.3 Knowledge and adoption gap of sugarcane growers regarding farm machinery and equipments

2.4 Mechanization needs of sugarcane growers

2.5 Constraints in use of farm machinery and equipments in sugarcane growers

2.1 Profile of the sugarcane growers

2.1.1 Age

Babu (1990) found that 46.20 per cent of registered sugarcane growers belonged to young age category, followed by old age category (32.70%) and only a few (21.15%) of the farmers were in the middle age group.

Karthikeyan (1994) found that out of the total respondents, one-third each of the registered sugar factory growers were in the age groups of young, middle and old.

Channal (1995) conducted a study on share holders and non-shareholders of sugarcane growers and reported that 18.00 per cent, 62.00 per cent and 20.00 per cent of share holders fell under the categories of young, middle and old age, respectively. Whereas, in case of non-share holders 26.00 per cent were young, 50.00 per cent in middle age and 24.00 per cent were under old age category.

Kanavi (2000) in a study on the knowledge and adoption behaviour of sugarcane growers in Belgaum district of Karnataka state and reported that (42.66%) of the respondents were in middle age followed by young age (30.66%) and old age (26.66%) respectively.

Nagaraja (2002) conducted a study on sugarcane growers in Davangere district of Karnataka, revealed that 78.33 per cent of the respondents were found with middle age category, whereas, 15.41 per cent and 6.25 per cent of respondents had fallen in the old and young age categories respectively.

Ghosh (2004) revealed that more than half of the sugarcane respondents (57.50%) belonged to old aged category followed by middle age group (35.00%) and young age (7.50%) category.

2.1.2 Education

Chandrasekaran (1979) observed that majority of the registered sugarcane growers (53.33%) had secondary level of education, whereas 41.67 per cent had primary level of education. A meagre per cent(5.00%) were found under collegiate group, while there were no illiterates.

Channal (1995) in a study on share holders and non-share holders of sugarcane growers in Belgaum district reported that 43.00 per cent of the share holders were under the category of primary and middle school followed by high school and PUC (36.00%), illiterate (17.00%) and graduate (4.00%), while in case of non-share holders 40.00 per cent had studied up to primary and middle school followed by high school and PUC (38.00%), graduates (12.00%) and illiterate (10.00%).

Kanavi (2000) found that (30.00%) of the respondents were illiterates followed by high school (22.00%), middle school (15.33%), primary school (11.33%), post graduates (9.33%) and 6 per cent in case of higher secondary and graduates.

Nagaraja (2002) in a study on sugarcane growers categorized the respondents namely middle school (29.58%) and high school (30.83%), primary school (25.00%) whereas (8.33%) illiterate only 1.25 per cent of the respondents were graduate.

Ghosh (2004) revealed that a large proportion (40.00%) of sugarcane growers had secondary level of education, followed by primary level (25.00%), middle (12.50%) and illiterates (10.00%).

2.1.3 Land holding

Channal (1995) categorized share holder and non-share holder on the basis of total land holding. According to her 10.00 per cent of the respondents were marginal farmers, six per cent small farmers and 93.00 per cent were big farmers in case of share holders. Whereas, in case of non-share holders three per cent were marginal, four per cent small and 93.00 per cent were big farmers.

Kanavi (2000) categorized sugarcane growers in to large farmer (61.33%), medium farmers (30.66%), semi-medium farmers (6.55%) and small farmers (1.33%). None of the farmers belonged to category of marginal farmers.

Nagaraja (2002) in a study on sugarcane growers has classified the respondent as marginal farmer (2.50%), small farmer (2.08%), semi-medium farmer (30.00%), followed by medium farmer (48.75%) and big farmer (16.66%).

Shashidhara (2003) in a study on socio-economic profile of drip irrigation farmers in Shimoga and Davanagere districts of Karnataka state revealed that comparatively more number of farmers (46.67%) belonged to semi-medium category followed by medium (32.22%) and small land holding category (18.89%).

Modi (2010) in study on knowledge and adoption of post harvest practices among the mango growers revealed that that around one-third of respondents (34.17%) were small farmers followed by semi-medium farmers (31.67%), whereas, medium farmers and marginal farmers were observed to the extent of 21.66 and 8.33 per cent respectively. And very less percentage (4.17%) belonged to big land holding category.

Satish (2010) revealed that 50.84 per cent of the respondents were medium land holders, 28.33 percent of them were big, 20 percent of them were small land holders and very negligible percent of them were marginal landholders. The average land holding of the respondent was 9 acres.

2.1.4 Farming experience

Lekshmi *et al.* (2006) in their study on yield gap analysis among rice growers in Northeast Zone of Tamil Nadu inferred that 30.00 per cent of the farmers fell under low category followed by 31.67 per cent in medium category and 38.33 per cent in high category of farming experience.

Kumar (2009) in his study indicated that majority (58.67%) of the respondents had medium farming experience (10 to 20 years), while 30.66 per cent of the respondents had high farming experience (more than 20 years) and 10.66 per cent of respondents had low farming experience.

2.1.5 Annual income

Babu (1990) found that nearly half (49.04%) of the cane growers studied were under low income group, followed by 28.85 per cent of the farmers were under high income group and the percentage is still less in medium income group (22.11%).

Channal (1995) in a study on share holders and non-share holders in Belgaum district of Karnataka state revealed that average income of share holders was Rs.62,149.63 and that of non share holders was Rs.41,746.72.

Narayanan (1996) observed that majority (56.45%) of the cane growers of the total sample possessed an annual income up to Rs.50,000 per annum. A little more than one-forth of them (26.00%) had income ranging from Rs.50,001-1,00,000 per year and the rest were in the range of Rs.1,00,001 - 2,00,000.

Kanavi (2000) found that none of the farmers were earning less than Rs.11,000/- per annum. The annual income of 2 and 9.33 per cent of the respondents family was between Rs.11,000/- to Rs.22,000/- and Rs.22,000/- to Rs.33,000/- respectively.

Nagaraja (2002) in a study of sugarcane growers in Davangere district of Karnataka state revealed that 7.50 per cent of farmer having income of Rs.20,000, 48.33 per cent and 35.83 per cent of respondents having annual income of Rs.20,001/- to Rs.50,000/- and Rs.50,001 to 1 lakh ,respectively.

Manjunath (2010) found that economic position of the families of the respondents indicated that only 38.85 per cent of them had annual income below Rs. 49,310.43, followed by 35.42 per cent of them had an annual income between Rs. 49310 to Rs. 1,21,217 and rest of the respondents (25.71%) had an income more than Rs. 1,21,217, annually.

Satish (2010) studied farmers perceptions, preferences and utilization of sri and traditional paddy straw for livestock and found that 36.66 percent of respondents belonged to high income group followed by medium (31.66%), semi medium (27.5%) income groups and 4.16 percent of them were in low income group.

2.1.6 Farm resources

Shabnam (2011) revealed that 49.00 per cent of the FFS participants belonged to low level of farm resources followed by medium level(25.83%) and high level (25.00%) of farm resource base.

2.1.7 Cropping intensity

Rotti (1983) conducted a study on sugarcane growers and reported that 42.50 per cent of farmers were under low category, 57.50 per cent of farmers where as under high category with 73.89 per cent and 72.72 per cent cropping intensity, respectively.

Rahim and Barman (1995) studied socio economic implication of farm mechanization in West Bengal and revealed that cropping intensity of the tractor owning farms was higher than that of the control group.

Anandaraja (1999) found that majority (60.63%) of the respondent farms had medium level of cropping intensity, followed by nearly one-forth (23.12%) with high level and 16.25 per cent of the farmers with low cropping intensity.

Kanavi (2000) conducted study on knowledge and adoption behaviour of sugarcane growers in Belgaum district of Karnataka and reported that 58.00 per cent of sugarcane growers were under low category of cropping intensity and 42.00 per cent of farmers under high category.

Nagaraja (2002) reported that 90.00 per cent of the sugarcane growers were found in low category of cropping intensity and (10.0%) were found in high category.

2.1.7 Extension contact

Karthikeyan (1994) indicated that more than half (54.17%) of the sugarcane growers maintained medium level of extension contact.

Sriram (1997) observed that 42.10 per cent of the cotton growers had medium level of extension agency contact and 33.80 per cent had high level of contact and 24.10 per cent of them had low level of extension agency contact.

Bheemappa (2001) while studying the knowledge and technological gap in adoption of paddy and cotton cultivation practices between migrant and non-migrant farmers of TBP command area concluded that 100.00 per cent migrant and 99.17 per cent non-migrant were aware of Agricultural Assistants of which 3.36 per cent non-migrant farmers were only found to contact Agricultural Assistants once in a week and 74.17 per cent migrant and 74.49 per cent non-migrant farmers contacted once in a month.

Sophia (2001) based on the study knowledge and adoption of sustainable cultivation practices in sugarcane and cotton by farmers in Cuddlore district of Tamil Nadu revealed that all the sugarcane farmers were aware of the sugarcane officers, among them 97.50% contacted them regularly, 73.75% of cotton farmers are aware of agricultural development officer.

2.1.8 Innovative proneness

Chandrasekaran (1979) observed that majority (59.17%) of the sugarcane farmers had medium degree of innovativeness, followed by 25.83 per cent with low innovativeness and 15.00 per cent with high degree of innovativeness.

Sriram (1997) reported that 53.00 per cent of the cotton growers had medium level of innovativeness, while 32.00 per cent had high and 15.00 per cent had low level of innovativeness.

Shashidhara (2003) in his study on socio-economic profile of drip irrigation farmers in Shimoga and Davangere district of Karnataka found out that, majority of the farmers belonged to medium innovativeness category (47.50%) followed by low (31.66%) and high (20.83%) innovativeness category, respectively.

2.1.9 Risk orientation

Karthikeyan (1994) found that a large proportion of small and big farmers 66.47 per cent and 40.00 per cent respectively had low level of risk orientation.

Gupta (1999) observed that majority (64.00%) of rice growers were average risk bearers followed by low (24.67%) and high (11.33%) risk bearers.

Nagaraja (2002) reported that a majority (74.85%) of the respondents were found to possess medium risk, whereas, 15.83 per cent and 9.58 per cent of the respondents were found belonging to high and low level of risk orientation, respectively.

2.1.10 Mass media utilization

Channal (1995) reported that 41.00 per cent of shareholders were reading news papers regularly followed by reading extension literatures (12.00%), listening radio (90.00%), viewing television (3.00%), whereas, in case of non-share holders 26.00 per cent were reading news papers, three per cent were reading extension literatures, 37.00 per cent were listening radio and only two per cent were viewing television.

Narayanan (1996) reported that majority (64.00%) of the sugarcane growers had medium level of media exposure. A little more than one-fourth of the farmers had low level of media exposure and the percentage of high level media exposure was negligible.

Gupta (1999) reported that all the respondents possessed radio 86.66 per cent of the respondents possessed television sets of which 72.00 per cent were regularly listening to agricultural programmes and 64.67 per cent of farmers were listening other programmes, while, 48.00 per cent and 41.00 per cent of farmers were regularly viewing agricultural and general programmes, respectively on television.

Kanavi (2000) reported that, 82.00 per cent of the respondents possessed radio, whereas television was owned by 42.66 per cent followed by 16.66 per cent subscribers to news paper and 2.00 per cent subscribing to agricultural magazines. As far as radio 19.33 and 6.00 per cent listened to agricultural progammes regularly and occasionally respectively. In case of television (13.33%) viewed regularly the agricultural programme followed by news (38.66%) and general programmes (15.33%).

Modi (2010) highlight that the television was the most popular mass media possessed by 90.83 per cent of the respondents, out of which 50.00 per cent viewed programme occasionally, while 36.67 per cent of them were regular viewers. Remaining 13.33 per cent of them never viewed television.

Satish (2010) that majority (80%) of the respondents were in low utilization group with respect to news paper followed by high (18.34%) and low utilization categories (1.66%). In case of radio, half of the respondents were in low radio utilization group followed by high (28.33%) and medium utilization group (21.67%).

Singh and Amar (2011) in their study on Economic and management aspects of sugar production from sugar beet found that majority of the sugarbeet growers (82.67%) had high extension contact while half of the droupouts (50.21%) belonged to medium extension contact and majority of non-growers (87.00%) had low mass media participation.

It can be concluded from above reviews that majority of the respondents belonged to middle age group with education up to high school level. Majority of the respondents possessed big land holdings with high annual income but low farming experience and low cropping intensity. However, majority of the respondents belonged to medium category of extension contact, innovative proneness and risk orientation with high level mass media participation.

2.2 Status of farm machinery and equipments

Dharmavardene and Krishnamurthi (1992) in their study on "An outline plan for the development for the development of sugar industry of Srilanka" reported that except for the initial land preparation which is carried out by using conventional farm machinery, the rest of the farm operations from planting to harvesting employ manual methods using family labour for sugarcane cultivation in Srilanka.

Shyam (1992) revealed that a tractor, a cultivator, a seed drill and at least one pumpset were owned by more than 92.00 per cent of the farmers and crop thresher by 72.50 per cent of the farmers in selected district of Maharashtra.

Rosssel *et al.* (2004) in their study on mechanization for harvesting and processing of dry crops reported that agricultural mechanization in Mexico still ranges from hand tools draught animals to mechanized equipment. The mechanization index is 0.44 kw/ha of energy.

Singh *et al.* (2004) in their study on manufacturing of agricultural implements in Manipur reported that agricultural mechanization in Manipur is still at very low level, as compared to other parts of the country. Most agricultural operations are done manually using traditional tools and implements except ploughing and puddling in valley land where tractors and power tillers are used. Indegeneous plough, animal drawn cultivators, spade, hand fork, grass slasher, sickles are the used tools and implements in the hill and valley lands.

Durgut and Arin (2005) studied the level and problems of Trakya vineyard and mechanization level were found as 33.75 kw/ha, 4.1 equipment unit per enterprise and 5.02 equipment unit per tractor. Mechanical energy usage for the most applications except tillage and sprayers was found to be insufficient.

Dharmavardane (2006) in his study on Trends in farm mechanization by sugarcane small land holders in Srilanka, reported that following levels of mechanization could be recognized in small holder sugarcane farming system in Srilanka: a) Traditional hand tool technology, b) Improved hand tool technology, c) Animal draught technology, d) Mechanical power technology at the level of single axle tractor and e) Mechanical power technology at the level of four wheel tractors.

Biswas and Sinha (2008) in their report on the status of use of modern implements and farm machinery and farm tools, reported that only 41.4 million ha which accounts for 28.95 percent of the cultivated area in India is mechanized.

Singh (2009) in his study on participation of animal resource in agricultural mechanization found that 90.00 percent of the farmers availed services of power tillers and tractors on hire only for first ploughing of their land and subsequently ploughing was done by animal resources.

Abid (2010) studied the levels of mechanization under different crop production operations and reported that mechanization in wheat ranked first (47.80%) followed by tillage (40.20%), irrigation (37.00%), plant protection (34.20%), sowing with seed drills and planters (28.90%).

Chandra (2010), reported the growth in the sales of tractors has been 8.00% since 1970 and during the last ten years (1991-2001) about two million tractors and 1,17,000 power tillers were sold in the country. The level of power availability has increased to 1.23 kw/ha.

Turker *et al.* (2011) studied the level of farm mechanization in southeastern Anatolia region in Turkey and found out that mechanization level in Anatolia was 0.63 kw/ha, 16 tractor per 1000 ha, 62.60 ha/tractor and 6.70 equipment/tractor which were very low compared to Turkeys average values 1.51 kw/ha, 42.40 tractor per 1000 ha, 23.60 ha per tractor and 7.60 equipment per tractor.

It can be concluded from the above reviews that majority of the respondents had low status of farm mechanization.

2.3 Knowledge and adoption gap of sugarcane growers regarding farm machinery and equipments

Goni (1983) studied trends in use of modern technologies and revealed that Mijilu recorded the least concentration (20.00%) of modern technologies while Muchalla (28.00%) followed by Kirya (27.00%) and Bahuli (25.00%).

Philip (1983) found that 96.00 per cent of the respondents had used hand operated sprayer and 14.17 per cent had used power sprayer for plant protection.

Sharan (1984) reported that the use of tractor by farmers was confined to only three operations *viz.,* preparatory tillage, landscaping and hullage.

Philip (1985) in his study on use of farm implements and machinery in farming system found that 96.00 per cent of the respondents had used hand operated sprayer and 14.17 per cent had used power sprayer for plant protection.

Saeed and Farooq (1987) found those common hand tools, power tractors and animal drawn equipment were used in Pakistan for weed control.

Tandon *et al.* (1987) observed that manual and animal operated drills were mostly used for cotton, groundnut and soyabean, while tractor drawn machines were used for drilling cotton and groundnut.

Awadhawal (1988) revealed that low-cost bullock implements of broad bed former and fertilizer application attachment, inter- row weeder and planter were used for groundnut crops.

Devani (1990) reported that for seed bed preparation farmers used tractor-operated rotavator, sugarcane stubble shaver and manually operated multipurpose tool carrier. Tractor mounted seed metering device (for mustard), three row bullock drawn planter (for groundnut), and tractor drawn ridge planter (for maize) were used by the farmers for sowing and fertilizer application. For plant protection, tractor mounted ultra low volume sprayer and self propelled power sprayer were used.

Sekar and Alagesan (1994) conducted a study in three revenue villages of Sour Arcot district of Tamil Nadu State and revealed that nearly two third of the respondents (65.00%) had medium knowledge about sugarcane technologies.

Shibayama and Hashem (1995) revealed that majority of the respondents, carried out weed control practices by using tools in upland conditions and rotary weeders in paddy fields.

Wasnik (1995) reported that 86.00 per cent of farmers expressed lack of technical know-how in different stages of crop production as major constraints in adoption of improved sugarcane technologies.

Meyer (2007) in his study on South African sugar industry reported that in South Africa, only about two per cent of the annual crop is harvested mechanically. Forty per cent of whole stalk sugarcane is either loaded manually onto transport vehicles or stacked in 3 to 5 tonne bundles to be transported by self loading tractor trailer combination. The remaining cane is mechanically loaded by grab and push pile loaders.

Abid (2010) reported that not only large farmers but it has been found that small and marginal farmers also adopt equipment for tillage, sowing, irrigation, spraying and threshing.

Tekwa *et al*. (2010) conducted a survey in order to assess the effectiveness of agricultural mechanization adoption on flood plain sugarcane farmers income in four locations and reported that there was higher concentration of traditional technologies among the farmers prior too the adoption of modern agricultural mechanization. Despite of awareness by extension workers, the study revealed that about 5.00 per cent of farmers were admant to the modern technological changes.

The above reviews reveal that majority of the respondents had medium knowledge about farm machinery and equipments while majority of the respondents low adoption category.

2.4 Mechanization needs of sugarcane growers

Edilbirt and Uichannco (1997) in their study on mechanizing the sugar industry in Philippines stated that cane loading is an arduous task which limits the productivity of manual cane cutters. Cane cutters can cut and load one tonne a day. So there is need for wider mechanical loaders in the sugar industry to improve harvesting efficiency.

Yadav and Choudhuri (2001) reported that overall requirement of labour for sugarcane cultivation is 33000 man-hours. Labour requirement for preparatory tillage, planting, irrigation, intercultural and other operations, harvesting and stripping are 331.50, 238.00, 337.50, 392.00, 816.00 and 11923.00 respectively. He emphasized on the need to develop and popularize sugarcane machinery system based on regional situation.

Dewangan *et al.* (2004) studied the scope of mechanization in Arunachal Pradesh and revealed that there is need for small tools to reduce human drudgery and also recommended modification of these tools to enhance field capacity and comfort of operation.

Primo (2008) in his study on evaluation of alternative containers to determine the working with fertilizer spreaders came out with conclusion that there is need to develop 1) Standard container constructed in accordance with ISO 5690/1, 2) Container of polythene sceen shading to prevent the ricochet of material,3) Containers composed of boxes,4) Containers composed by flowerpots.

It can be concluded from the above reviews that need was felt to develop and popularize machinery region wise.

2.5 Constraints in use of farm machinery and equipments in sugarcane growers

Philip (1983) revealed that 98.33 per cent of electric pump users expressed that there was frequent power cut in day time effecting regular and periodical irrigation, a little less than two third of the farmers (65.83%) pointed out that country plough had been taking more time to cover unit area and about 88.33 per cent of the respondents said that they came across frequent repairs while using power sprayers.

Kamble *et al.* (1990) observed that about cent per cent of the respondents said that there was non-availability of improved implements, lack of skilled labour, cost of production is excessive and there is lack of capital as well as availability in time.

Iqbal (1992) found that 75.00 per cent of the farmers felt that fragmentation of land into small pieces is a major constraint in the adoption of agricultural mechanization.

Panday (1998) surveyed India for long term mechanization strategy at national level and came out with important challenges viz., the lack of control organization development, lack of integrated programmes to educate farmers in mechanization and lack of information systems in the mechanization field.

Anandaraja (1999) reported that more than half of the respondents (58.00%) expressed more hiring charges with farm equipments, followed by 45.00 per cent respondents expressed frequent power cuts as a major constraint one third of the respondents (33.33%) expressed small and fragmented and holdings and 50.00 per cent expressed constraint in availability of farm equipment and credit.

Shibayama and Hashem (1995) revealed that majority of the respondents, carried out weed control practices by using tools in upland conditions and rotary weeders in paddy fields while less than twenty percent respondents used hand tools for weeding.

Alagesan (2001) in his study on tractor drawn seed drill reported that a little more than on fourth of the respondents (26.67%) expressed the constraints as removal of reminance seed hopper after completion of sowing followed by more seed requirement (20.00%), toppling of machinery at the time of crossing bunds (16.67%) and the side wheel in the machinery is problematic (13.33%).

Shashi (2004) reported that the major constraint faced by sugarcane growers was high hire charges (92.50%) followed by lack of training on use of farm machinery and tools (67.50%) small and fragmented land holdings (60.00%), high fuel cost (55.00%).

Singh *et al.* (2004) observed that the major constraints in mechanization of agriculture in India are diverse ecology, small and fragmented land holdings, farmer's reluctance to change, rural employment, and low economic return from farm. Reliability after sale service, inadequate fuel and electricity, lack of proper mechanization policy, lack of skilled manpower, unsuitability of machines for Indian conditions and soil type.

Zang *et al.* (2006) in their study on soil compaction induced by small farm tractor in Northeast China reported that with the development of mechanical tillage in China, the problem of soil compaction is significantly increased, causing potential yield reductions.

Pechon *et al.* (2007) studied the effect of hand tractor implements on soil physical properties and revealed that low efficiency and substandard machines are common problems in agricultural mechanization in developing countries. Results showed non-power rotary tiller attained highest temperature and highly affected the porosity of soil.

Mahatma *et al.* (2008) in their study on input cost of tractor operations came to conclusion that one of the important constraints faced by farmers was management of farm machinery and equipment. Farmers in Ghana are poor at maintenance resulting to high production cost and low returns on investment.

Sakharam (2008) in his study on tractor operated whole-stalk sugarcane harvester reported that base cutter of sugarcane harvester caused considerable losses and dragged soil in the harvest material in the field condition.

Singh (2009) in his study on participation of animal resource in agricultural mechanization in North East India reported that tractors and power tillers could not reach 50 to 60 percent of farmers fields due to presence of water logged areas and eroded roads.

Bagheri and Moazzen (2010) studied the most important challenges for farm mechanization in Iran and reported four important challenge groups namely: social, economical, planning and management. The study also showed that important parts of challenges were related to human resources.

Chandra (2010) found various constraints in promotion of mechanizations include varied requirement for each agro-climate zone, small and fragmented land holdings, low investment capacity of farmers and repairs and maintenance facilities.

Hassan (2010) in his study on efficiency of mechanical cane loading in Egypt reported that due to constraints in field conditions, the loader efficiency of infield loading was reduced to 54.00 per cent while efficiency of loading railway wagons was as high as 81.00 per cent.

The above reviews reveal that fragmentation of land holdings, non availability of improved farm implements and low invest capacity of the farmers were the major constraints in mechanization of agriculture.

3. METHODOLOGY

In the present chapter, general typology and description of the research method and procedures adopted in the investigation are explained under the following heads

3.1 Research design

3.2 Locale of the study

3.3 Brief description of the study area

3.4 Selection of talukas and villages

3.5 Selection of respondents

3.6 Operationalization and measurement of variables

3.7 Quantification of status of mechanization in sugarcane cultivation

3.8 Quantification of constraints in use of farm implements

3.9 Procedure followed for data collection

3.10 Statistical tools used

3.1 Research design

The research design adopted for the study was “ex-post-facto” since the phenomena had already occurred and the design was considered appropriate.

3.2 Locale of the study

This study was conducted in Belgaum district of Karnataka. Based on the maximum area under sugarcane cultivation, five talukas falling under Belgaum i.e., Athani, Raibag, Gokak, Chikkodi and Hukkeri were considered for the study.

3.3 Brief description of the study area

Phisiography:

Belgaum district is located in the Northern part of the state. It lies between 15°23’ and 16°58’ North latitude and 74°78’ East longitude with the geographical area of 13,44,382 ha. The district is situated at a height ranging from 450 to 900 m above mean sea level and extends over physiographic units of Western ghats and plains. The district is surrounded by Maharashtra state in the North, Bijapur district in the East, Dharwad and Uttar Kannada district in South, Goa district in South East. The major rivers flowing in the area are Krishna, Ghataprabha and Malaprabha. This district has soil ranging from very deep black soil to red loamy and lateritic soil.

The talukas falling under Belgaum district are as follows:

District	Talukas
Belgaum	Belgaum Khanapur Hukkeri Bailhongal Gokak Ramdurg Sauadatti Athani Chikkodi Raibag

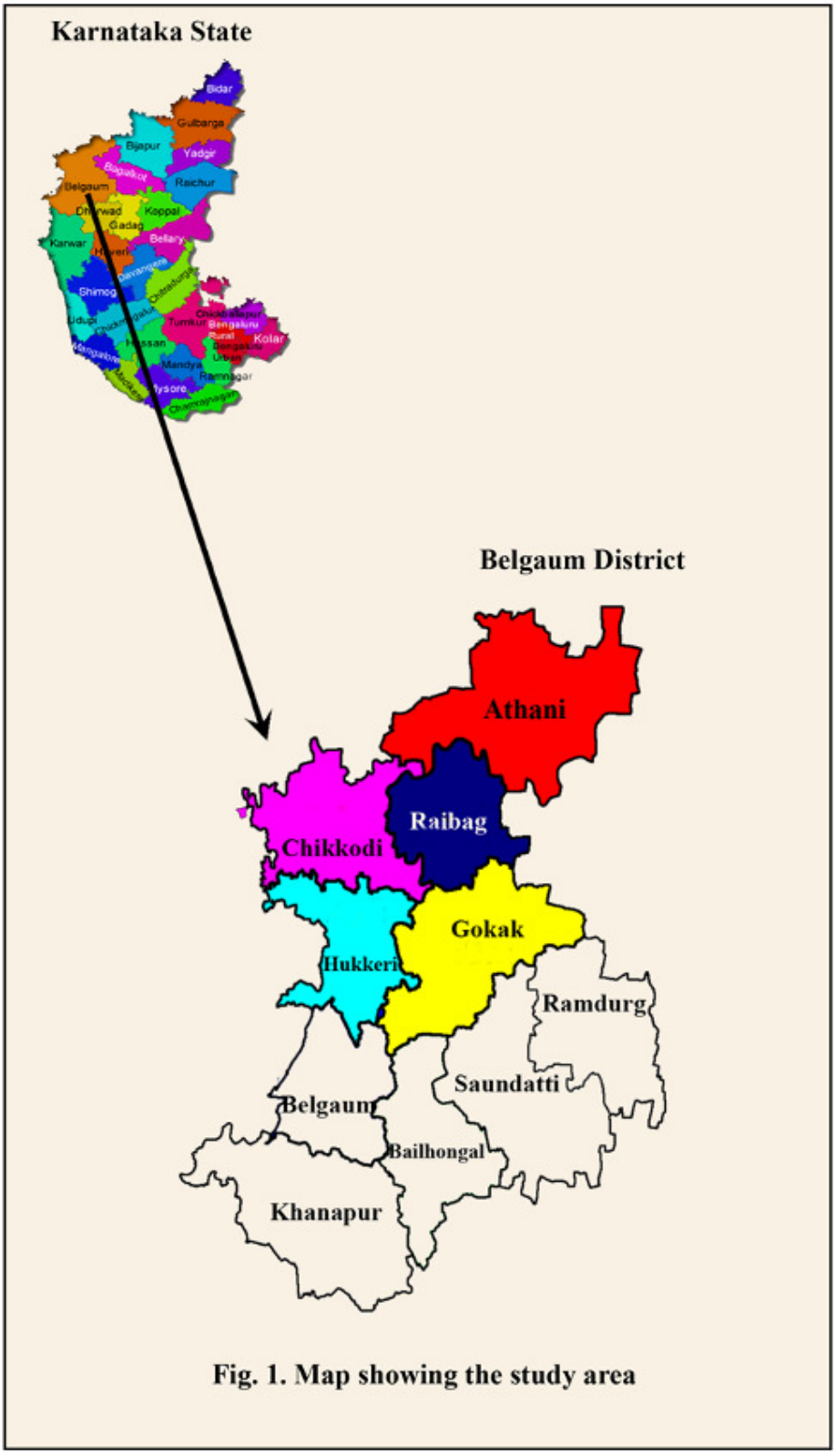

Fig. 1. Map showing the study area

Fig. 1. Map showing the study area

The area spreads in five talukas of Belgaum district falling in north dry zone (zone 3). The area under study is 675,784 ha out of which 532,828 ha is being cultivated. Out of the cultivated area 331,531 ha has irrigation facility. Crops are grown in kharif, rabi and summer season.

Temperature and rainfall:

The average temperature observed ranges between 12℃ (minimum) to 38℃ (maximum) with an average rainfall of 882.6 mm.

Population:

Belgaum district has population of 4,778,439. It ranks 25th in India with density of 356 inhabitants per square kilometer. Its population growth rate over the decade 2001-2011 was 13.38 per cent. Belgaum district has the maximum number of people living in rural area accounting for 35.60 lakh.

Occupation:

Main occupation in the district is agriculture. Of the 13,44,382 ha geographical area, 7,23,459 ha is cultivated and 1,69,841 ha area is cultivated more than once. Sugarcane, maize, cotton, tobacco, paddy, jowar, pulses, fruits and vegetables are main crops.

Literacy :

Average literacy rate of Belgaum district is 73.94 per cent with male and female literacy rate of 82.90 per cent and 64.74 per cent respectively.

3.4 Selection of talukas and villages

3.4.1 Selection of talukas

Based on the area under sugarcane cultivation, top five talukas were selected viz., Athani, Raibag, Gokak, Chikkodi and Hukkeri.

3.4.2 Selection of villages

Two villages from each taluka were selected based on the highest area under sugarcane cultivation which are as follows:

Talukas	Villages
a)Athani	i) Shedbal ii) Daroor
b) Raibag	i) Raibag grameena ii) Kudachi
c) Gokak	i) Sanginkeri ii) Gujanatti
d) Chikkodi	i) Eksamba ii) Nez
e) Hukkeri	i) Bagevadi ii) Ammangi

3.5 Selection of respondents

A total of 150 respondents, 10 sugar factories and 10 jaggery units formed the sample of the study. Stratified random sampling was followed for selection of respondents with 50 small (<2.5 ac land) , medium (2.5-5.00 ac) and big (>5.00 ac) each.

3.6 Operationalization and measurement of variable

3.6.1 Operationalization and measurement of dependent variables

Considering the objectives of the study, knowledge gap, adoption gap and mechanization needs were considered as dependent variables.

3.6.1.1 Knowledge gap

A teacher made test as suggested by Anastasi (1961) was employed to measure the knowledge level of the respondents in consultation with the experts and scientists of University of Agricultural Sciences, Dharwad. Twenty three equipments and farm machinery were finally selected for inclusion in the knowledge test (Appendix I).Each implement was credited with one score. The maximum that one could obtain was 23. The knowledge score of each individual was converted into knowledge index as follows

$$\text{Knowledge index} = \frac{\text{No. of correct responses}}{\text{Total no. of knowledge items}} \times 100$$

Thus after computing the knowledge index, respondents were grouped into low, medium and high categories by taking mean and standard deviation as a measure of check.

Category	Score
Low	Less than ($\bar{X}$- 0.425 SD)
Medium	In between ($\bar{X}$±0.425 SD)
High	More than ($\bar{X}$+0.425 SD)

Knowledge gap = 100- knowledge index

3.6.1.2 Adoption gap

The procedure followed by Sengupta (1967), for calculation of adoption quotient was used to measure the general adoption level of the respondents

$$\text{Adoption quotient} = \frac{\text{Actual score obtained}}{\text{Max. score that could be obtained}} \times 100$$

Depending on the total score obtained by each respondent, they were grouped into three categories with mean and standard deviation as a measure of check.

Category	Score
Low	Less than ($\bar{X}$-0.425 SD)
Medium	In between ($\bar{X}$±0.425 SD)
High	More than ($\bar{X}$+0.425 SD)

Adoption gap = 100- adoption quotient

3.6.1.3 Mechanization needs

Farm machinery and equipments used for cultivation of sugarcane were listed out in consultation with the scientists of University of Agricultural Sciences, Dharwad. They were presented as two point scale to arrive at their mechanization need based on the extent of need for farm machinery and equipments in sugarcane cultivation. Based on the information obtained, mechanization needs of the respondents were classified into the following categories.

Category	Mechanization need
I II	Most needed Needed

Informal discussions were carried out with sugarcane growers and cane development officers to find out the mechanization needs in sugarcane cultivation.

3.6.2 Variables and their empirical measurements

Sl.no	Variables	Measurement tools
1.	Dependent variables	
	a) Knowledge gap	Followed by Anastasi(1961)
	b) Adoption gap	Followed by Sengupta(1967)
	c) Mechanization needs	Procedure developed
2.	Independent variables	
	a) Age	Followed by Wondang(2010)
	b) Education	Followed by Wondang(2010)
	c) Land holding	Followed by Wondang(2010)
	d) Farming experience	Followed by Wondang(2010)
	e) Annual income	Followed by Naik(2005)
	f) Farm resource base	Followed by Shabnam(2011)
	g) Cropping intensity	Followed by Wondang(2010)
	h) Innovative proneness	Followed by Wondang(2010)
	i) Risk orientation	Followed by Wondang(2010)
	j) Extension contact	Followed by Wondang(2010)
	k) Mass media participation	Followed by Shabnam(2011)

3.6.2.1 Age

Age was operationalized as the chronological age of the sugarcane grower in completed years at the time of investigation. The respondents were categorized into three age groups based on the procedure followed by Wondang (2010).

Category	Age (years)
Young	18-30
Middle	31-50
Old	51 and above

3.6.2.2 Education

Education refers to the number of years of formal schooling obtained by the sugarcane growers. It was quantified using the items and weights used by Wandang (2010).

Education	Score
Illiterate	0
Primary school (1^{st}- 4^{th} std)	1
Middle school (5^{th}- 7^{th} std)	2
High school(8^{th}- 10^{th} std)	3
Pre-university	4
Graduate	5

3.6.2.3 Land holding

It refers to the number of acres of land possessed by the farmers.

Category	Land holding (in acres)
Small farmers	Up to 2.50
Medium farmers	2.51 – 5.00
Big farmers	Above 5.00

3.6.2.4 Annual income

Annual income earned by the respondent was assessed considering the following items:

Main income: It was conceived as the income derived from farming during the previous year.

Subsidiary income: The income obtained by the respondents from source other than farming during the previous year. The procedure followed by Naik (2005) was used. The annual income of the respondents was grouped in three categories based on mean and standard deviation.

Category	Score
Low	Less than (Mean- 0.425 SD)
Medium	Between (Mean $\pm$ 0.425 SD)
High	More than (Mean+ 0.425 SD)

3.6.2.5 Farming experience:

In this study, it is referred to as the total number of years of experience the farmer has in farming.

Farming experience in sugarcane cultivation: The total number of years sugarcane is being cultivated. The farmers were categorized based on their experiences as followed by Wondang(2010),the categories of the farmers were as follows:

Category	Score
Low	Less than (Mean-0.425 SD)
Medium	Between (Mean $\pm$0.425 SD)
High	More than (Mean+0.425 SD)

3.6.2.6 Farm resources

Farm resources were operationalised as the type and extent of resource base of the farmer that support crop production system. The resources such as land, water, livestock and farm equipments were considered to compute farm resources. The procedure followed by Shabnam (2011) was used. The components and items score assigned are as follows:

Resource type	Category	Score
Land type	Black	3
	Red	2
	Non arable	1
Water	Irrigated	3
	Rainfed	1
Livestock	Draft animal	3
	Buffalo	3
	Sheep and goat	2
	Poultry	2
Farm equipments	Tractor	1
	Bullock cart	1
	Plough	1
	Other equipments	1

Based on the total score of farm resources, the respondents were classified into three categories such as 'low', 'medium' and 'high' by considering mean and standard deviation as a measure of check.

Category	Score
Low	Less than ($\bar{X}$-0.425SD)
Medium	Between ($\bar{X}\pm$0.425SD)
High	More than ($\bar{X}$+0.425SD)

3.6.2.7 Cropping intensity

It is the index of agricultural development which is defined as the ratio of gross cropped area to net cultivated area. The cropping intensity was calculated according to the procedure followed by Wondang(2010). The index used for calculating cropping intensity was as follows

$$\text{Cropping Intensity} = \frac{\text{Total cropped area in a year}}{\text{Net area sown}} \text{ x } 100$$

Category	Scores
Low	Upto100
High	100 and above

3.6.2.8 Innovative proneness

This refers to the behavior of an individual who has interest and desire to seek changes in farming techniques and ready to introduce such changes into his operations when considered as practical and feasible. Self rating innovative proneness scale was used to measure the innovative proneness of the farmer. This scale consists of three sets of statements, each set contained two statements with weights 2 and 1 indicating 'most like' and 'least like' respectively. The scoring was done by summing up of scores of the weights of the 'most like' statements and weights of 'least like' statements. Respondents were categorized based on mean and SD as the measure of check. Higher score of the respondents reveal more innovativeness of the respondents.

Category	Score
Low	Less than (Mean-0.425 SD)
Medium	Between (Mean $\pm$0.425 SD)
High	More than (Mean+0.425 SD)

3.6.2.9 Risk orientation

It is operationalized as the degree to which a farmer is oriented towards risk and uncertainty and has the courage to face various risks involved in farming. Risk orientation was measured with the help of risk orientation scale scale developed by Supe (1969) and as followed by Shashidhara (2006).The scale consisted of six statements , of which first and fifth statements were negative and all the others were positive. The items were rated on five point continuum ranging strongly agree, agree, undecided, disagree and strongly disagree with weightages of 5,4,3,2 and 1 for positive statements and 1,2,3,4 and 5 for negative statements respectively. The scores ranged from 6 to 30.

Based on the scores, the respondents were grouped into three categories by using mean and standard deviation a measure of check.

3.6.2.10 Extension Contact

The frequency of contact of a respondent with extension agency during the previous year was taken into consideration. The variable was quantified by Deepak (2003) and as followed by Wondong (2010). The score of an individual respondent was the summation of scores for all the extension perssonnel contacted by the respondents.

Sl.No	Frequency of contact	Score
1.	Contacted once in week	3
2.	Contacted once in fortnight	2
3.	Contacted when needed	1
4.	Never contacted	0

Based on the total scores of extension contact, the respondents were classified into three categories such as 'low', 'medium' and 'high' using mean and standard deviation as a measure of check

Category	Score
Low	Less than (Mean-0.425 SD)
Medium	Between (Mean $\pm$0.425 SD)
High	More than (Mean+0.425 SD)

3.6.2.11 Mass media exposure

It refers to extent of use of mass media such as radio, television, news papers and agriculture Magazines by the respondents. The respondents were asked to indicate their degree of participation in terms of listening, viewing and reading behavior. The data was presented in terms of frequency and percentage. The variable was quantified on the basis of procedure followed by Shabnam (2011).

Subscription/possession	Score
Subscriber /Owned	1
Non subscriber/Not owned	0
Behavior of listening/reading/viewing	Score
Regular	2
Occasional	1
Never	0

The composite score was arrived at by summing up the score obtained by respondent and were classified into three categories by using mean and standard deviation as measure of check.

Category	Criteria
Low	Less than ($\bar{X}$-0.425SD)
Medium	Between ($\bar{X}$±0.425SD)
High	More than ($\bar{X}$+0.425SD)

3.7 Quantification of status of mechanization in sugarcane cultivation

In the light of the present study the term mechanization refers to use of hand tool technology, equipments used with animal draft technology and machinery operated with mechanical or electrical power technology.

In order to quantify the status of farm implements the following procedure was used:

A list of various farm machinery and equipments used in cultivation of sugarcane was made in consultation with the experts and scientists of UAS, Dharwad. Twenty three farm machinery and equipments were finally selected for inclusion. Each implement was credited with one score. The maximum score that one could obtain was 23. The status of farm machinery and equipments was converted to percentage.

Depending upon the total score obtained by each respondent, they were grouped into three categories with mean and standard deviation as a measure of check.

Category	Score
Low	Less than ($\bar{X}$-0.425 SD)
Medium	In between ($\bar{X}$±0.425 SD)
High	More than ($\bar{X}$+0.425 SD)

3.8 Quantification of constraints in farm mechanization

To identify the constraints in use of farm implements, the probable constraints were listed out in discussion with scientists. Responses obtained from sugarcane growers were analysed using frequency and percentage.

3.9 Procedure followed for data collection

Keeping in view the objectives and variables of the study, a structured interview schedule was developed by consulting experts and referring to the relevant literature. Pretesting of the schedule was carried out in non sample area for its practicability and relevancy. The final schedule was prepared by making necessary corrections, additions and deletions based on pre testing results. The final format of the interview schedule is given in Appendix II.

The data was collected from the respondents through personal interview method in an informal atmosphere.

3.10 Statistical tools used

The following statistical tools were used to analyze the data.

Mean: The arithmetic mean is the sum of the score divided by their number. This measure was used to categorize the dependent and independent variables into low, medium and high categories.

Frequency: This measure was used to know the distribution pattern of respondents variable wise and to categorize the problems perceived by sugarcane growers in order of importance.

Percentage: This measure was used for simple comparison.

Standard deviation: This measure was used to categorize the dependent and independent variables into low, medium and high categories.

Correlation test: Karl Pearsons simple correlation test was used to find out the nature of relationship between dependent and independent variables.

4. RESULTS

The results of the study are presented under the following headings

4.1 Profile of the sugarcane growers

4.2 Status of farm machinery and equipments possessed by the sugarcane growers

4.3 Knowledge gap of the sugarcane growers of individual farm machinery and equipments

4.4 Overall knowledge gap of the farm machinery and equipments of the sugarcane growers

4.5 Adoption gap of the sugarcane growers in use of individual farm machinery and equipments

4.6 Overall adoption gap of the farm machinery and equipments of the sugarcane growers

4.7 Mechanization needs of sugarcane growers

4.8 Mechanization needs of sugar factories

4.9 Mechanization needs of jaggery making units

4.10 Association between personal characteristics and knowledge gap of the sugarcane growers

4.11 Association between personal characteristics and adoption gap of the sugarcane growers

4.12 Constraints faced by the sugarcane growers in farm mechanization

4.1 Profile of the sugarcane growers

The data presented in Table 1, 2, 3, and 4 (Fig. 2, 3, 4) gives a detail account of personal, socio- economic and psychological attributes of the sugarcane growers. The details are presented under the following sub heads:

4.1.1 Age

The results presented in Table 1 indicate that 62.00 per cent of the sugarcane growers belonged to middle age, whereas 25.33 per cent and 12.67 per cent belonged to old age and young age, respectively.

4.1.2 Education

With regard to education, the results showed that 24.67 per cent of the farmers studied up to PUC, while 22.67 per cent and 16.67 per cent farmers studied upto high school and middle school,respectively. About sixteen per cent of the respondents were graduates and 17.33 per cent of farmers were illiterates. A meagre 2.67 per cent of the farmers had education upto primary school.

4.1.3 Land holding

As stratification of the sample population was done on the basis of land holding, equal proportion (33.33%) of the farmers belonging to small, medium and big landholdings were selected for the study.

4.1.4 Farming experience in agriculture

Nearly of the sugarcane growers (46.67%) had ‘low’ farming experience, whereas 29.33 per cent of the farmers had high farming experience followed by 24.00 per cent of sugarcane growers who had medium farming experience in agriculture.

4.1.5 Farming experience in sugarcane cultivation

The data pertaining to farming experience in sugarcane cultivation reveals that 48.67 per cent of the sugarcane growers had low experience in sugarcane cultivation while 36.00 per cent and 15.33 per cent had high and medium experience in sugarcane cultivation, respectively.

Table 1: Profile of the sugarcane growers

(n=150)

Sl. no	Variables	Category	F	%
1	Age	Young (<31 years)	19	12.67
		Middle (31-50 years)	93	62.00
		Old (>51 years)	38	25.33
2	Education	Illiterate	26	17.33
		Primary school	4	2.67
		Middle school	25	16.67
		High school	34	22.67
		PUC	37	24.67
		Graduate	24	16.00
3	Land holding	Small (<2.5 ac)	50	33.33
		Medium (2.5 ac-5.0 ac)	50	33.33
		Big (5.0 ac and above)	50	33.33
4	Farming experience in agriculture	Low (<15.43 years)	70	46.67
		Medium (15.43-26.84 years)	36	24.00
		High (>26.84 years)	44	29.33
5	Experience in sugarcane cultivation	Low (<17.56)	73	48.67
		Medium(17.56-24.51 years)	23	15.33
		High(>24.51 years)	54	36.00
6	Annual income	Low(<20733.66)	20	13.33
		Medium(20733-90125.00)	34	22.67
		High(>90125.00)	96	64.00
7	Farm resources	Low (<10.73)	62	41.33
		Medium (10.73-13.20)	34	22.66
		High (>13.20)	54	36.00
8	Cropping intensity	Low (upto 100)	0	0
		High (100 and above)	150	150
9	Extension contact	Low(< 1.45)	74	49.33
		Medium(1.45-2.67)	34	22.67
		High(> 2.67)	42	28.00

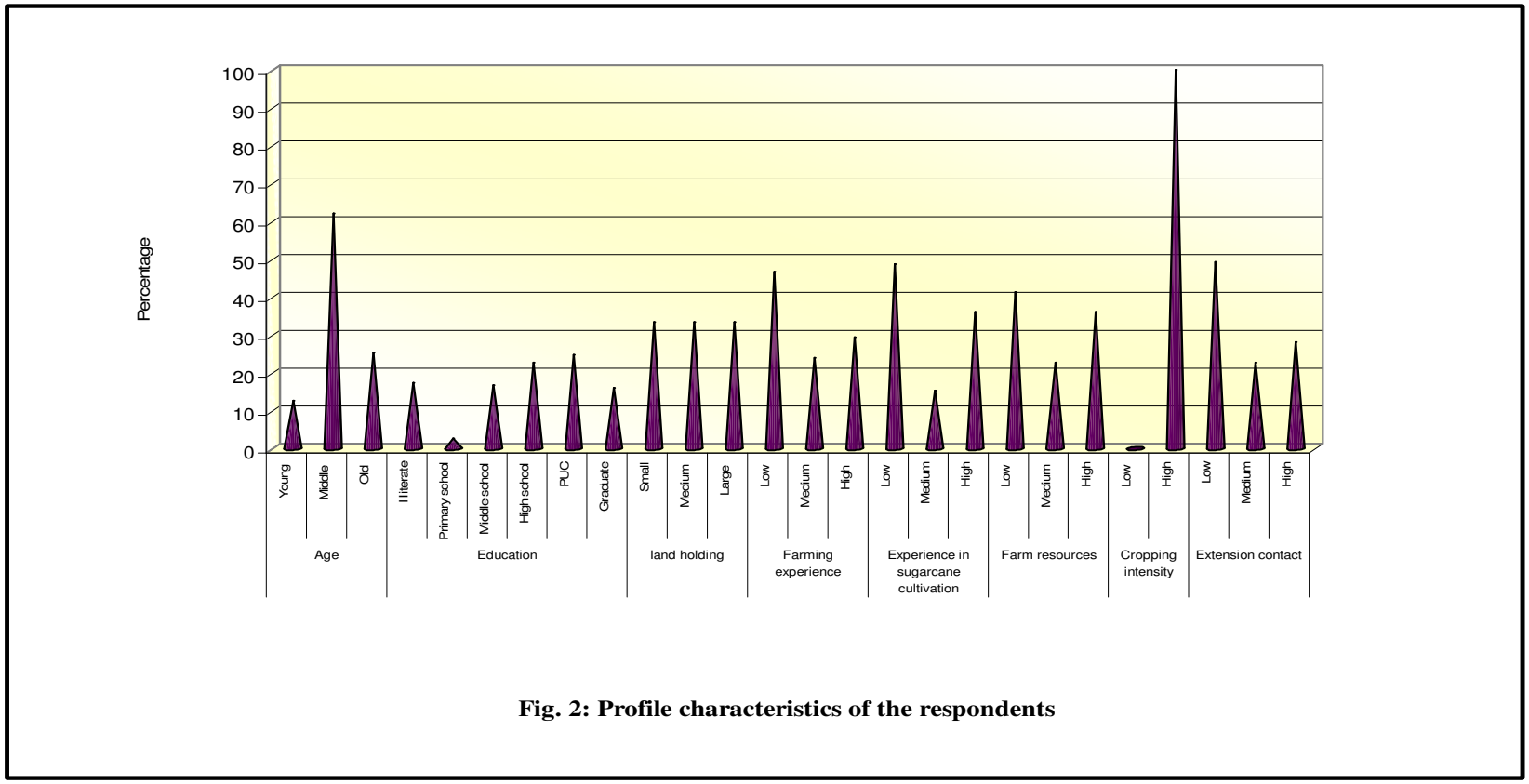

Fig. 2: Profile characteristics of the respondents

Fig. 2: Profile characteristics of the respondents

4.1.6 Annual income

It was found that 64.00 per cent of the sugarcane growers had high annual income while 22.67 per cent and 13.33 per cent of sugarcane growers belonged to medium and low annual income category, respectively.

4.1.7 Farm resources

Farm resources were computed by considering the different resources like land, livestock, water and material possession. Farm resources were found to be low among 41.33 per cent followed by high (36.00%) and medium (22.66%).

4.1.8 Farming intensity

It was found that cent per cent of the farmers had high cropping intensity.

4.1.9 Extension contact

It was evident from the data that 49.33 per cent of the farmers had low extension contact, while 28.00 per cent of the farmers had high extension contact. Medium extension contact was observed in 22.67 per cent of growers.

4.1.10 Psychological attributes of the sugarcane growers

4.1.10. a) Innovative proneness

Table 2 and Fig. 3 indicated that 43.33 per cent of the sugarcane growers belonged to medium category of innovativeness followed by 30.67 per cent in 'low' and 26.00 per cent in 'high' categories, respectively.

4.1.10. b) Risk orientation

In their behavior of taking risk, 49.33 per cent of sugarcane growers had medium level of risk taking ability followed by 'high' (28.67%) and low (22.00%) level of risk orientation.(Table 2 and Fig.2)

4.1.11 Extent of utilization of mass media by the sugarcane growers

It is interesting to note from Table 3 that all most all the sugarcane growers (99.33%) possessed television whereas only 21.33 per cent of the sugarcane growers subscribed newspaper and even lesser percentage (8.00%) of them subscribed farm magazines.

The data pertinent to mass media utilization revealed that 77.33 per cent of the sugarcane growers did not read newspaper to know general or agricultural news whereas 20.00 per cent of the sugarcane growers read general news regularly and 19.33 percent of them read agricultural news regularly. A very less proportion of the sugarcane growers (2.67% and 3.33%) read news papers occasionally to know general news and agricultural news, respectively.

As regards to the farm magazines an overwhelming majority of the sugarcane growers (93.33% and 92.00%) never read general articles and agricultural articles, respectively. It can also be seen that only 6.67 per cent of sugarcane growers read general articles in farm magazines and 8.00 per cent of them read agricultural articles.

The table also revealed that 98.00 per cent of the sugarcane growers never listened to general or agricultural programmes in radio. The other 2.00 per cent of the sugarcane growers listened to general as well as agricultural programmes in radio occasionally.

As high as 61.30 per cent of the sugarcane growers occasionally viewed general programmes in television followed by 34.67 per cent who viewed general programmes regularly in television. Only 4.00 per cent of them never viewed general programmes in television. It is interesting to note that a greater percentage,(46.67%) of the farmers regularly viewed agricultural programmes and only 1.33 per cent of the sugarcane growers never viewed agricultural programmes. More than half of the sugarcane growers (52.00 %) occasionally viewed agricultural programmes.

Table 2: Psychological attributes of sugarcane growers

(n=150)

Sl. No	Variables	Category	F	%
1	Innovative proneness	Low(<12.94)	46	30.67
		Medium (12.94-16.22)	65	43.33
		High (>16.22)	39	26.00
2	Risk orientation	Low (<20.32)	33	22.00
		Medium (20.32-22.56)	74	49.33
		High (>22.56)	43	28.67

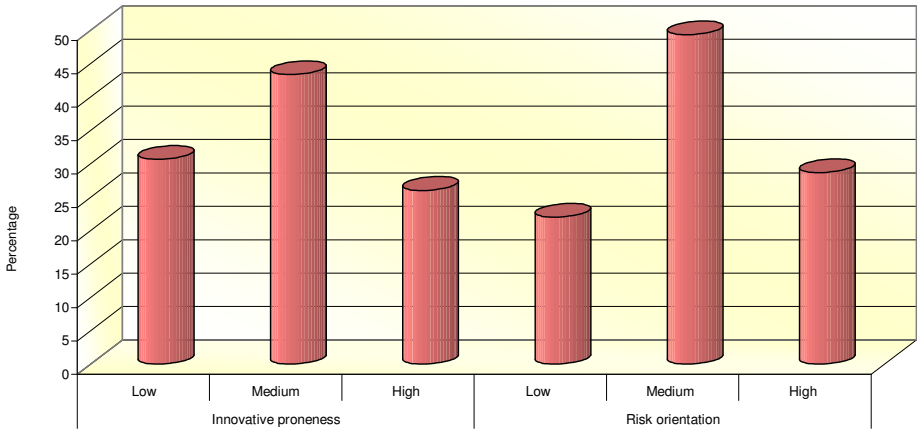

Fig. 3: Psychological attributes of respondents

Fig. 3: Psychological attributes of respondents

Table 3: Extent of utilization of mass media by the sugarcane growers

(n=150)

Sl. no	Mass media	Subscriber/Possession		Reading/Listening/Viewing habit					
				Regular		Occasional		Never	
		F	%	F	%	F	%	F	%
1	News paper	32	21.33						
	a. General news			30	20.00	4	2.67	116	77.33
	b. Agricultural news			29	19.33	5	3.33	116	77.33
2	Magazines	12	8.00						
	a. General articles			10	6.67	0	0.00	140	93.33
	b. Agricultural articles			12	8.00	0	0.00	138	92.00
3	Radio	1	0.67						
	a. General programmes			0	0.00	3	2.00	147	98.00
	b. Agricultural programmes			0	0.00	3	2.00	147	98.00
4	Television	149	99.33						
	a.General programmes			52	34.67	92	61.33	6	4.00
	b .Agricultural programmes			70	46.67	78	52.00	2	1.33

Table 4: Distribution of sugarcane growers based on mass media participation

(n=150)

Sl. No	Variables	Category	F	%
1	Mass media participation	Low (<3.65)	70	46.67
		Medium(3.65-5.18)	48	32.00
		High(>5.18)	32	21.33

Mean= 3.65 SD=3.59

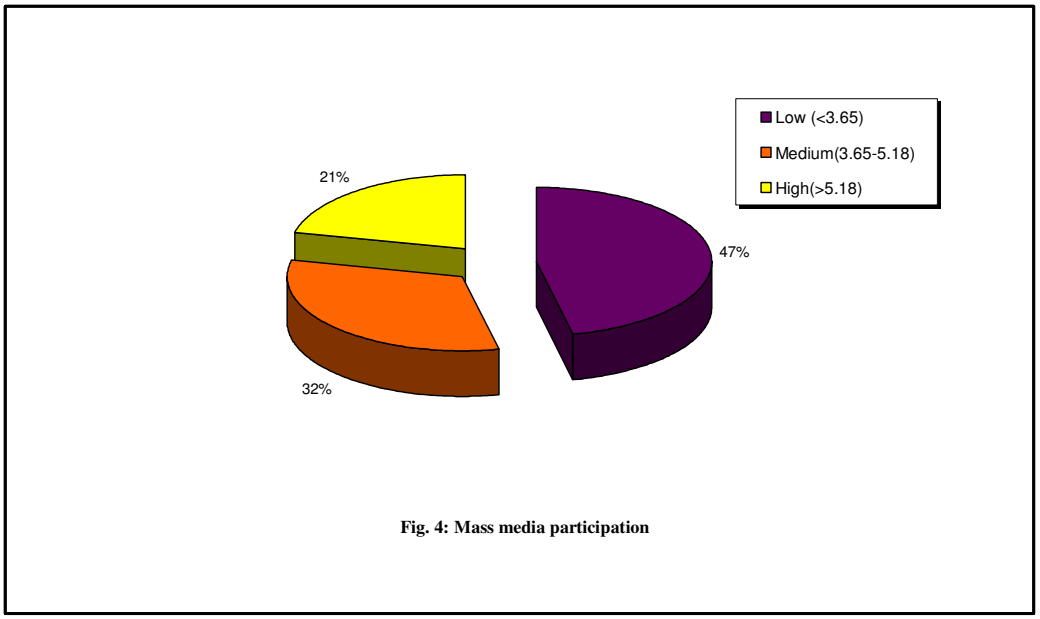

Fig. 4: Mass media participation

Fig. 4: Mass media participation

4.1.12 Overall mass media participation

Table 4 and Fig. 4 clearly shows that 46.67 per cent of the sugarcane growers had low mass media participation followed by 32.00 per cent and 21.33 per cent in medium and high level, respectively.

4.2 Status of farm machinery and equipments

Table 5 clearly shows that slightly more than half of the sugarcane growers (51.33%) hire country plough and only 48.67 per cent of farmers owned country plough. Majority of big farmers (74.00%) owned country plough while just 18.00 percent of small farmers owned country plough. Cultivator was owned by only 16.67 per cent of the sugarcane growers. Forty six per cent of big farmers and 4.00 per cent of medium farmers possessed cultivator. Similarly disc plough and heavy duty ridger were possessed by 16.67 per cent farmers while 46.00 per cent of big farmers possessed both disc plough and heavy duty ridger.

Cent per cent of the respondents, irrespective of small medium and big farmers owned spade, bore well pump set and sickle. Less than half of the sugarcane growers (42.00%) possessed manual weeder. More than half of the small farmers (54.00%) possessed manual weeder followed by big farmers(40.00%) and medium farmers(34.00%), respectively. Fairly higher number of big farmers (38.00%) owned drip followed by (30.00% and 26.00%) small and medium farmers, respectively. Equal proportion of small and big farmers i.e, 26.00 per cent owned sprinkler sets followed by 16.00 per cent medium farmers accounting for total 22.66 per cent. Majority of the sugarcane growers (90.66 %) owned open well pump set. An overwhelming majority of the big farmers (98.00%) owned open well followed by 94.00 per cent medium farmers and 80.00 per cent small farmers.

It can also be seen from the table that large majority of the sugarcane growers (98.00%) owned knapsack sprayer. Eighty four per cent of big farmers own knapsack sprayer followed by 72.00per cent of the medium farmers. More than three forth (79.00%) of the sugarcane growers owned power sprayer. Seventy six per cent of the big farmers owned power sprayer followed by 56.00 percent medium and 26.00 per cent small farmers. Only 19.00 per cent of the sugarcane growers owned tractor rotavator. Small farmers did not own tractor rotavator where as 36.00 per cent of big farmers owned tractor rotavator followed by just 2.00 per cent by medium farmers.

Overall status of farm machinery and equipments can be clearly depicted from the Table 6 and Fig.5 that 46.00 per cent of small farmers had low status of farm machinery followed by 32.00 per cent of medium farmers and 26.00 per cent big farmers respectively. Forty per cent of small and big farmers belong to high status of farm machinery and equipments. Thirty six per cent of the medium farmers belonged to medium category of status of farm machinery and equipments followed by (34.00% and 14.00%) big and small farmers, respectively.

4.3 Knowledge gap of the sugarcane growers of individual farm machinery and equipments

Table 7 brings to the light individual implement wise knowledge gap of the sugarcane growers w.r.t. individual equipment. It is interesting to note that all the sugarcane growers (100.00%) did not have any knowledge about irrigation channel former, bullock drawn sugarcane planter, sett cutter cum planter, sugarcane detrasher and whole stack harvester among which majority are specific to sugarcane cultivation. On the other hand all of them had knowledge about country plough, disc plough, heavy duty ridger, spade, knapsack sprayer, power sprayer sickle and tractor rotavator, accounting for knowledge gap in these farm machinery.

With regard to mechanization in irrigation there was no knowledge gap. All the sugarcane growers had knowledge about open well and bore well pump sets. Interestingly there was no knowledge gap in drip and sprinkler technologies as well.

Majority of the sugarcane growers (61.33%) expressed knowledge gap about power weeder. Anyhow there was 36 per cent knowledge gap among the small farmers followed by 48.00 per cent and 98.00 per cent in medium and large farmers respectively. Knowledge gap about manual weeder was comparatively lesser than power weeder.

Table 5: Status of farm machinery and equipments

Sl. no	Farm machinery/equipments	Small n_1=50				Medium n_2=50				Big n_3=50				Total n=150			
		Own		Hire		Own		Hire		Own		Hire		Own		Hire	
		F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	Country plough	9	18.00	41	82.00	27	54.00	23	46.00	37	74.00	13	26.00	73	48.67	77	51.33
2	Bund former	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3	Cultivator	0	0.00	45	90.00	2	4.00	43	86.00	23	46.00	22	44.00	25	16.67	110	73.33
4	Disc plough	0	0.00	50	100.00	2	4.00	48	96.00	23	46.00	27	54.00	25	16.67	125	83.33
5	Heavy duty ridger	0	0.00	50	100.00	2	4.00	48	96.00	23	46.00	27	54.00	25	16.67	125	83.33
6	Irrigation channel former	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7	Bullock drawn sugarcane planter	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8	Set cutter cum planter	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9	Spade	50	100.00	0	0.00	50	100.00	0	0.00	50	100.00	0	0.00	150	100.00	0	0.00
10	Power weeder	0	0.00	0	0.00	0	0.00	0	0.00	1	2.00	0	0.00	1	0.67	0	0.00
11	Manual weeder	27	54.00	0	0.00	16	34.00	0	0.00	20	40.00	0	0.00	63	42.00	0	0.00
12	Drip irrigation	15	30.00	0	0.00	13	26.00	0	0.00	19	38.00	0	0.00	47	31.33	0	0.00
13	Sprinkler	13	26.00	0	0.00	8	16.00	0	0.00	13	26.00	0	0.00	34	22.66	0	0.00
14	a. Open well	40	80.00	0	0.00	47	94.00	0	0.00	47	94.00	0	0.00	136	90.66	0	0.00
	b. Bore well	50	100.00	0	0.00	50	100.00	0	0.00	50	100.00	0	0.00	150	100.00	0	0.00
15	Knapsack sprayer	20	40.00	1	2.00	36	72.00	14	28.00	42	84.00	8	16.00	98	65.33	23	15.33
16	Boom sprayer	0	0.00	0	0.00	0	0.00	0	0.00	5	10.00	0	0.00	5	3.33	0	0.00
17	Power sprayer	13	26.00	37	74.00	28	56.00	22	44.00	38	76.00	12	24.00	79	52.67	71	47.33
18	Sickle	50	100.00	0	0.00	50	100.00	0	0.00	50	100.00	0	0.00	150	100.00	0	0.00
19	Sugarcane detrasher	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
20	Whole stalk harvester	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
21	Sugarcane harvester	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
22	Power tiller rotavator	0	0.00	0	0.00	3	6.00	0	0.00	3	6.00	0	0.00	6	4.00	0	0.00
23	Tractor rotavator	0	0.00	50	100.00	1	2.00	49	98.00	18	36.00	32	64.00	19	12.67	131	87.33

Table 6: Distribution of the sugarcane growers according to status of farm machinery and equipments

(n=150)

Sl. No	Variable	Category	F	%
1	Small	Low (<25.20)	23	46.00
		Medium(25.20-29.41)	7	14.00
		High(>29.41)	20	40.00
2	Medium	Low (<25.70))	16	32.00
		Medium(25.70-31.73)	18	36.00
		High(>31.73)	16	32.00
3	Big	Low (<28.73)	13	26.00
		Medium(28.73-36.54)	17	34.00
		High(>36.54))	20	40.00

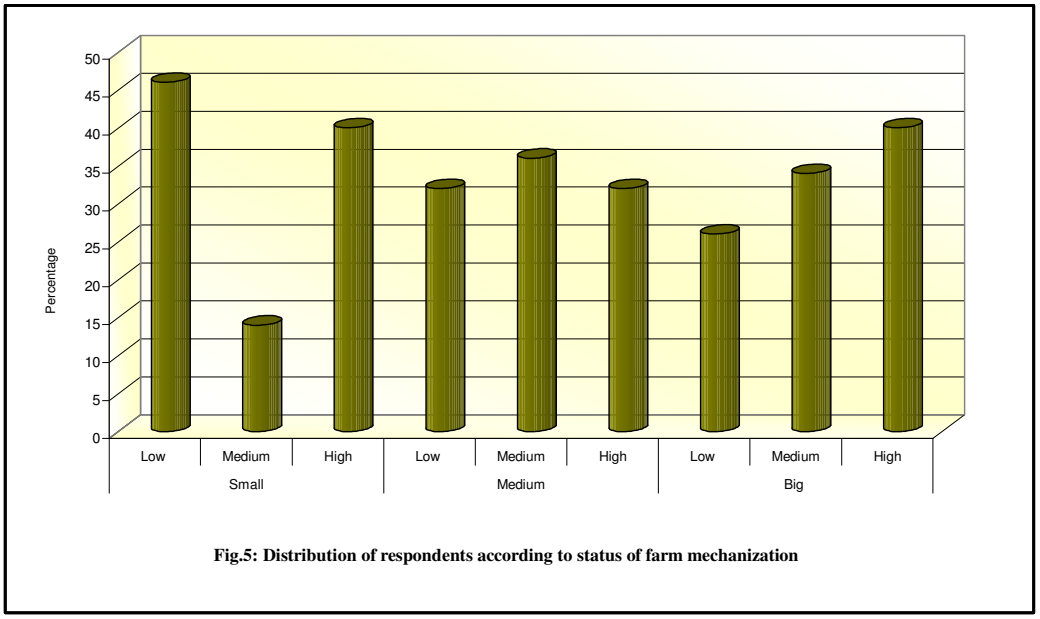

Fig.5: Distribution of respondents according to status of farm mechanization

Fig.5: Distribution of respondents according to status of farm mechanization

Table 7: Knowledge gap of sugarcane growers of individual farm machinery and equipments

Sl. no	Farm machinery and equipments	Knowledge gap						Total n=150	
		Small n_1=50		Medium n_2=50		Big n_3=50			
		F	%	F	%	F	%	F	%
1	Country plough	0	0.00	0	0.00	0	0.00	0	0.00
2	Bund former	18	36.00	17	34.00	16	32.00	51	34.00
3	Cultivator	5	10.00	5	10.00	5	10.00	15	10.00
4	Disc plough	0	0.00	0	0.00	0	0.00	0	0.00
5	Heavy duty ridger	0	0.00	0	0.00	0	0.00	0	0.00
6	Irrigation channel former	50	100.00	50	100.00	50	100.00	150	100.00
7	Bullock drawn sugarcane planter	50	100.00	50	100.00	50	100.00	150	100.00
8	Set cutter cum planter	50	100.00	50	100.00	50	100.00	150	100.00
9	Spade	0	0.00	0	0.00	0	0.00	0	0.00
10	Power weeder	18	36.00	24	48.00	49	98.00	92	61.33
11	Manual weeder	10	20.00	9	18.00	11	22.00	30	20.00
12	Drip irrigation	0	0.00	0	0.00	0	0.00	0	0.00
13	Sprinkler irrigation	0	0.00	0	0.00	0	0.00	0	0.00
14	Pump set								
	a. Open well	0	0.00	0	0.00	0	0.00	0	0.00
	b. Bore well	0	0.00	0	0.00	0	0.00	0	0.00
15	Knapsack sprayer	0	0.00	0	0.00	0	0.00	0	0.00
16	Boom sprayer	45	90.00	42	84.00	45	90.00	132	88.00
17	Power sprayer	0	0.00	0	0.00	0	0.00	0	0.00
18	Sickle	0	0.00	0	0.00	0	0.00	0	0.00
19	Sugarcane detrasher	50	100.00	50	100.00	50	100.00	150	100.00
20	Whole stalk harvester	50	100.00	50	100.00	50	100.00	150	100.00
21	Sugarcane harvester	10	20.00	7	14.00	6	04.00	23	15.33
22	Power tiller rotavator	5	10.00	8	16.00	5	12.00	18	12.00
23	Tractor rotavator	0	0.00	0	0.00	0	0.00	0	0.00

Only 30.00 per cent of farmers did not have knowledge about manual weeder. Twenty two per cent of big farmers followed by 20.00 per cent and 18.00 per cent small and medium farmers respectively do not have knowledge about manual weeder.

Knowledge gap about the bund former accounted to 34.00 per cent out of which (36.00%, 34.00% and 32.00%) gap was noticed among small, medium and big farmers respectively. Interestingly 10.00 per cent of the small, medium and big farmers each, did not possess knowledge about cultivator accounting to an average total of 10.00 per cent.

Majority of the sugarcane growers (88.00%) were not aware about boom sprayer. Ninety per cent knowledge gap was seen in both small and big farmers and 84.00 per cent knowledge gap about boom sprayer was observed in medium farmers.

There was only 15.33 per cent gap in knowledge about sugarcane harvester where 20.00 per cent gap was found among small farmers followed by 14.00 per cent and 12.00 per cent among medium and big farmers respectively. Only 12.00 per cent knowledge gap was seen in power tiller rotavator. Ten per cent gap was seen with both small and big farmers while a slightly higher (16.00%) gap was seen among medium farmers.

4.4 Overall knowledge gap of the farm machinery and equipments of the sugarcane growers

Table 8 and Fig.6 clearly indicates that 50.00 per cent of the small farmers belong to high knowledge gap followed by medium (44.00%) and big farmers (40.00%). Thirty eight per cent of the big farmers had medium level of knowledge gap followed by 30.00 per cent among small farmers and 22.00 per cent among medium farmers.

4.5 Adoption gap of the sugarcane growers in use of individual farm machinery and equipments

Table 9 clearly illustrates that all the sugarcane growers (100.00%) did not use seven farm machineries viz., bund former, irrigation channel former, bullock drawn sugarcane planter, set cutter cum planter, sugarcane detrasher, whole stalk harvester and sugarcane harvester. There was no adoption gap in use of country plough, disc plough, heavy duty ridger, spade, knapsack sprayer, power sprayer, sickle and tractor rotavator. Interestingly only 10.00 per cent gap was seen in adoption of cultivator accounting for 10.00 per cent each of small, medium and big farmers.

Majority of the sugarcane growers (99.33%) did not use power weeder. Cent per cent the small and medium farmers and 98.00 percent of large farmers did not use power weeder. In case of manual weeder least adoption gap was seen in small farmers (46.00%) followed by (60.00% and 68.00%) among big and medium farmers, respectively.

It can also be learnt from the table that all the sugarcane growers (100.00%) used bore well for irrigation. It can be noticed that 14.00 per cent adoption gap can be seen in open wells with medium farmers. Sixty eight per cent gap in use of drip irrigation with maximum of 74.00 per cent among medium farmers followed by 70.00 per cent among small farmers and 62.00 per cent among big farmers. Greater adoption gap (77.33%) is seen in sprinkler use compared to drip irrigation. There was 84.00 per cent gap among medium farmers followed by 74.00 per cent gap each among both small and big farmers.

The table further highlighted that 96.66 per cent adoption gap was seen in use of boom sprayer with cent percent gap among small and medium farmers. Similarly 92.00 per cent gap can be seen in adoption of power tiller rotavator with 90.00 per cent gap among big farmers followed by 86.00 per cent gap among medium farmers. All the small farmers (100.00%) did not use power tiller rotavator.

Table 8: Distribution of sugarcane growers according to knowledge gap

(n=150)

Sl. no	Variable	Category	F	%
1	Small	Low (<15.92)	10	20.00
		Medium(15.92-17.87)	15	30.00
		High(>17.87)	25	50.00
2	Medium	Low (<16.20)	17	34.00
		Medium(16.20-18.23)	11	22.00
		High(>18.23)	22	44.00
3	Big	Low (<15.82)	11	22.00
		Medium(15.82-17.93)	19	38.00
		High(>17.93)	20	40.00

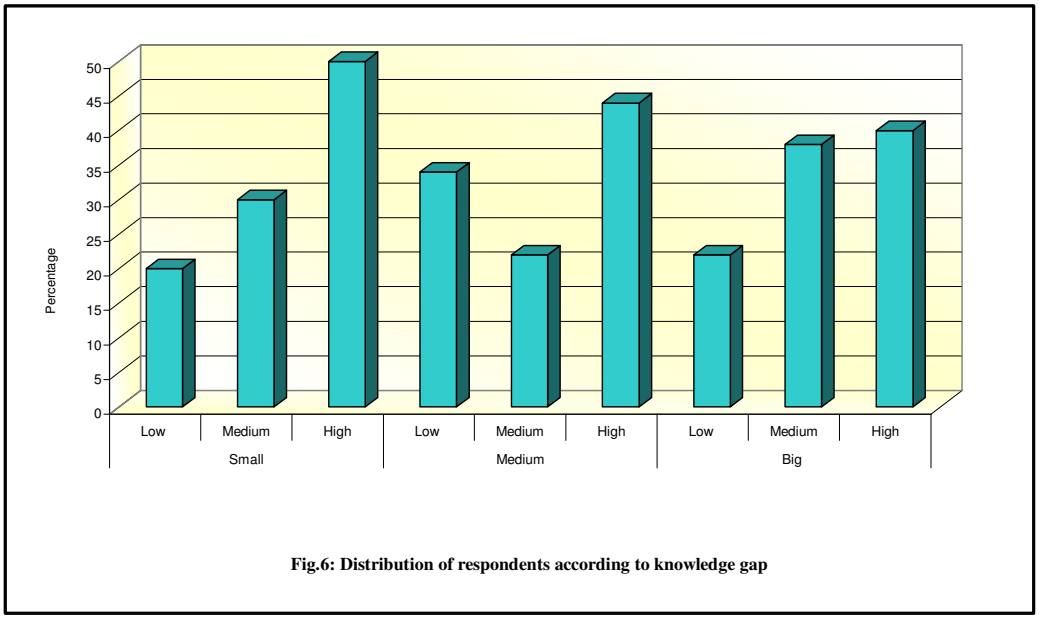

Fig.6: Distribution of respondents according to knowledge gap

Fig.6: Distribution of respondents according to knowledge gap

Table 9: Adoption gap of sugarcane growers of individual farm machinery and equipments

(n=150)

Sl. No	Farm machinery and equipments	Adoption gap						Total n=150	
		Small n_1=50		Medium n_2=50		Big n_3=50			
		F	%	F	%	F	%	F	%
1	Country plough	0	0.00	0	0.00	0	0.00	0	0.00
2	Bund former	50	100.00	50	100.00	50	100.00	150	100.00
3	Cultivator	5	10.00	5	10.00	5	10.00	15	10.00
4	Disc plough	0	0.00	0	0.00	0	0.00	0	0.00
5	Heavy duty ridger	0	0.00	0	0.00	0	0.00	0	0.00
6	Irrigation channel former	50	100.00	50	100.00	50	100.00	150	100.00
7	Bullock drawn sugarcane planter	50	100.00	50	100.00	50	100.00	150	100.00
8	Set cutter cum planter	50	100.00	50	100.00	50	100.00	150	100.00
9	Spade	0	0.00	0	0.00	0	0.00	0	0.00
10	Power weeder	50	100.00	50	100.00	49	98.00	149	99.33
11	Manual weeder	23	46.00	34	68.00	30	60.00	87	58.00
12	Drip irrigation	35	70.00	37	74.00	31	62.00	103	68.67
13	Sprinkler irrigation	37	74.00	42	84.00	37	74.00	116	77.33
14	Pump set								
	a. Open well	3	6.00	10	20.00	1	2.00	14	9.33
	b. Bore well	0	0.00	0	0.00	0	0.00	0	0.00
15	Knapsack sprayer	0	0.00	0	0.00	0	0.00	0	0.00
16	Boom sprayer	50	100.00	50	100.00	45	90.00	145	96.67
17	Power sprayer	0	0.00	0	0.00	0	0.00	0	0.00
18	Sickle	0	0.00	0	0.00	0	0.00	0	0.00
19	Sugarcane detrasher	50	100.00	50	100.00	50	100.00	150	100.00
20	Whole stalk harvester	50	100.00	50	100.00	50	100.00	150	100.00
21	Sugarcane harvester	50	100.00	50	100.00	50	100.00	150	100.00
22	Power tiller Rotavator	50	100.00	43	86.00	45	90.00	138	92.00
23	Tractor Rotavator	0	0.00	0	0.00	0	0.00	0	0.00

4.6 Overall adoption gap of the farm machinery and equipments of the sugarcane growers

Table 10 and Fig.7 clearly shows that 46.00 per cent of medium farmers had low adoption gap followed by 26.00 per cent and 20.00 per cent among small and big and medium farmers, respectively. More than half of the big farmers (54.00%) had medium level of adoption gap followed by 38.00 per cent among small farmers and 24.00 per cent medium farmers. Thirty six per cent of the small farmers had high level of adoption gap followed by 26.00 per cent and 24.00 per cent big and medium farmers, respectively.

4.7 Mechanization needs of sugarcane growers

Table 11 and Fig. 8, 9, 10 and 11 brings to light the stage wise mechanization needs of sugarcane growers. It is interesting to know that both in weeding and harvesting stages cent per cent of sugarcane growers irrespective of small, medium and big farmers felt that mechanization was most needed. Cent per cent of the sugarcane growers also felt the need of mechanization in planting. Slight variation was seen among small, medium and big farmers but majority of small and medium farmers (84.00%) and 88.00 per cent of big farmers felt that mechanization in planting operation was most needed. Relatively lesser number of sugarcane growers, small (16.00%), medium (16.00%) and big (12.00%) felt that mechanization in planting operation was just needed. More than half of the sugarcane growers (64.00%) felt that there was need for mechanization in irrigation, while very few (3.33%) of the sugarcane growers felt mechanization was most needed in irrigation. Majority of the small farmers (74.00%) felt that further mechanization in irrigation is needed followed by (60.00% and 58.00%) big and medium farmers respectively. Only 12.6 per cent of the sugarcane growers felt that mechanization in earthing up was most needed. Cent per cent of the sugarcane growers did not report any mechanization needs in field preparation, pest and disease management and stubble removing.

4.8 Mechanization needs of sugar factories

Table 12 clearly indicates that 50.00 per cent of the sugar factories felt that mechanization in sugarcane weighing and crushing was most needed under boiling stage only. Twenty per cent of the units felt the need for mechanization. Ten per cent of the factories reported that mechanization in boiling was most needed and remaining 10.00 per cent felt that it was needed. Thirty per cent of the sugar factories felt that further mechanization was needed in sugar processing and only one unit (10.00%) felt that mechanization was most needed in power generation.

4.9 Mechanization needs of jaggery making units

It can be clearly seen from table 13 that all the jaggery making units (100.00%) felt that further mechanization was needed in juice extraction, filtration, cooling and packing stages. An over whelming majority of the units (90.00%) reported that mechanization in filtration was most needed followed by 60.00 per cent and 40.00 per cent in cooling/packing and juice extraction, respectively. Sixty per cent of the units reported mechanization needs in juice extraction followed by 40.00% per cent in cooling and packing. Mechanization in powder making was reported most needed by only 10.00 per cent of the units.

4.10 Association between personal characteristics and knowledge gap of the sugarcane growers

Table 14 shows the relation between various independent variables and knowledge gap of the sugarcane growers. Knowledge gap is negatively significant with land holding, annual income, cropping intensity, extension contact and mass media participation of the sugarcane growers at one per cent level of significance whereas farm resource is negative significance at 5 per cent level of significance. Knowledge gap did not show any significant relation with other variables.

Table 10: Distribution of sugarcane growers according to adoption gap

(n=150)

Sl. No	Variable	Category	F	%
1	Small	Low(<11.31)	13	26.00
		Medium(11.31-12.56)	19	38.00
		High(>12.56)	18	36.00
2	Medium	Low (<10.83)	23	46.00
		Medium(10.83-12.32)	12	24.00
		High(>12.32)	15	30.00
3	Big	Low (<10.90)	10	20.00
		Medium(10.90-12.73)	27	54.00
		High(>12.73)	13	26.00

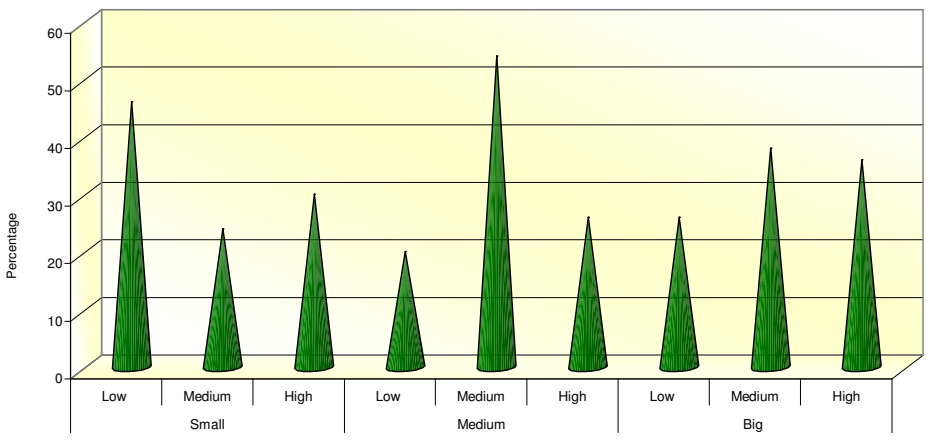

Fig. 7: Distribution of respondents according to adoption gap

Fig. 7: Distribution of respondents according to adoption gap

Table 11: Mechanization needs of sugarcane growers

Sl. No.	Stages	Small				Medium				Big				Total			
		n=50				n=50				n=50				n=150			
		Most needed		Needed		Most needed		Needed		Most needed		Needed		Most needed		Needed	
		F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	Weeding	50	100.00	0	0.00	50	100.00	0	0.00	50	100.00	0	0.00	150	100.00	0	0.00
2	Harvesting	50	100.00	0	0.00	50	100.00	0	0.00	50	100.00	0	0.00	150	100.00	0	0.00
3	Planting	42	84.00	8	16.00	42	84.00	8	16.00	44	88.00	6	12.00	128	85.33	22	14.67
4	Irrigation	0	0.00	37	74.00	0	0.00	29	58.00	5	10.00	30	60.00	5	3.33	96	64.00
5	Earthing up	5	10.00	0	0.00	8	16.00	0	0.00	6	12.00	0	0.00	19	12.67	0	0.00
6	Field preparation	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7	Pest and disease management	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8	Stubble removing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

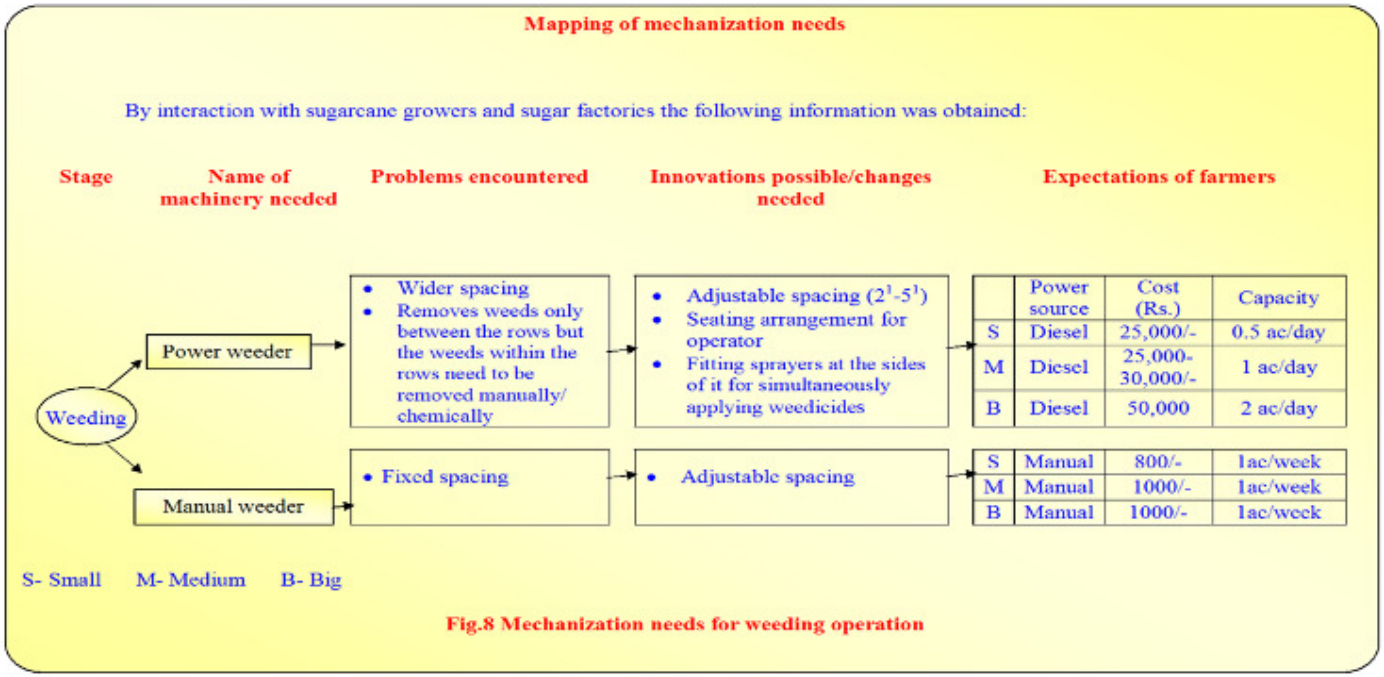

Fig.8 Mechanization needs for weeding operation

Fig. 8: Mechanization needs for weeding operation

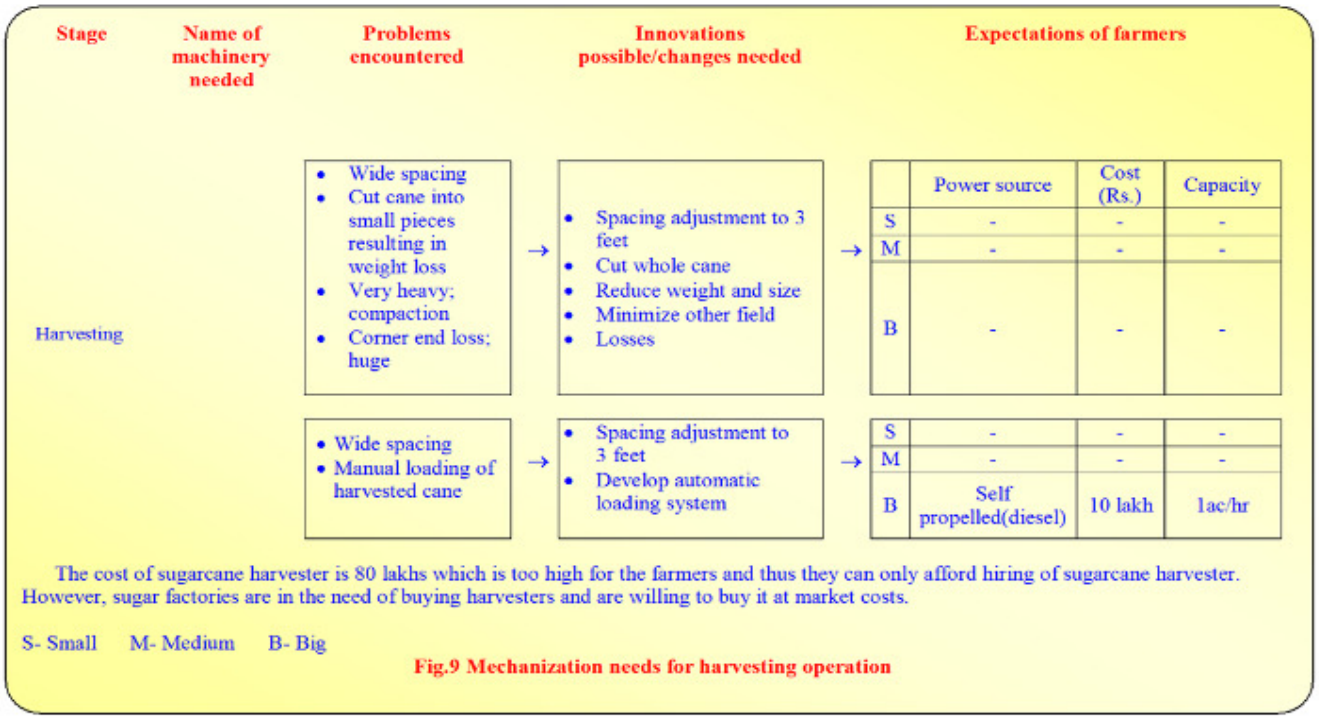

Fig. 9: Mechanization needs for harvesting operation

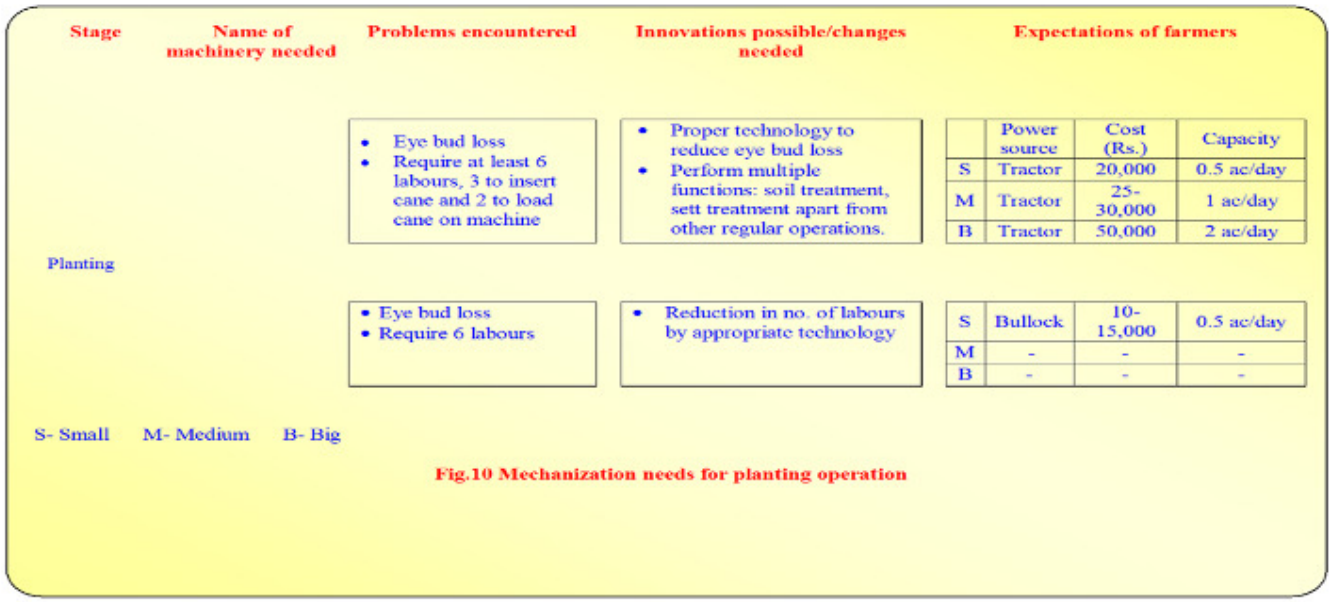

Fig. 10: Mechanization needs for planting operation

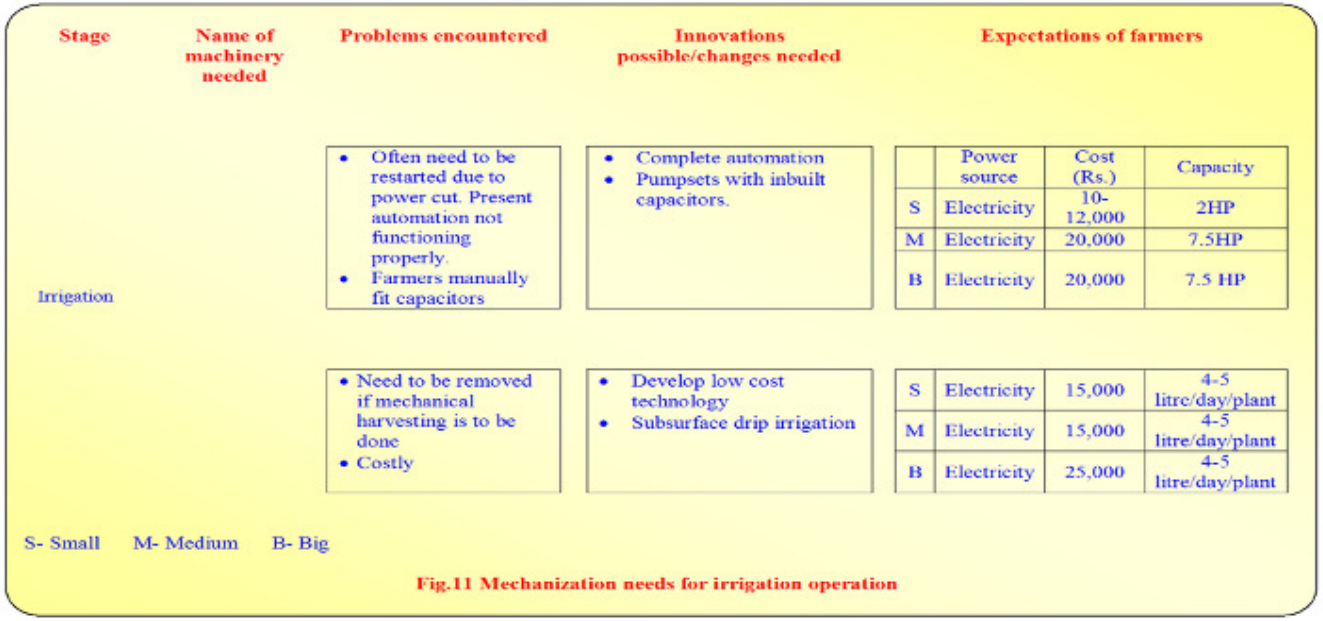

Fig. 11: Mechanization needs for irrigation operation

Table 12: Mechanization needs of sugar factories

(n=10)

Sl. no	Stages	Needed		Most needed		Total	
		F	%	F	%	F	%
1	Cane weighing and crushing	5	50.00	0	0.00	5	50.00
2	Boiling	1	10.00	1	10.00	2	20.00
3	Sugar processing	3	30.00	0	0.00	3	30.00
4	Power generation	0	0.00	1	10.00	1	10.00

Table 13: Mechanization needs of jaggary making units

(n=10)

Sl. no	Stages	Needed		Most needed		Total	
		F	%	F	%	F	%
1	Juice extraction	6	60.00	4	40.00	10	100.00
2	Filtration	1	10.00	9	90.00	10	100.00
3	Cooling and packing	4	40.00	6	60.00	10	100.00
4	Powder making	0	0.00	1	10.00	1	10.00

4.11 Association between personal characteristics and adoption gap of the sugarcane growers

The correlation between independent variables and adoption gap of the sugarcane growers is presented in Table 15. Out of 11 variables studied to access their relationship with adoption gap land holding and mass media participation showed negative correlation at 1 per cent level of significance while farming experience in sugarcane cultivation was negatively significant at 5 per cent level of significance. Other independent variables are not significantly correlated with adoption gap of the sugarcane growers.

4.12 Constraints faced by the sugarcane growers in farm mechanization

The constraints faced by sugarcane growers in farm mechanization d and presented in Table 16.

Cent per cent the sugarcane growers (100.00%) expressed high initial and maintenance cost, high fuel cost, small and fragmented land holdings and non availability of farm machinery for planting, earthing up, weeding and harvesting as the major constraints faced by them. Majority of the sugarcane growers (80.00%) felt that low resale value of the farm machinery and unsuitable and inappropriate farm machinery were also the constraints faced by them followed by 74.67 per cent who reported higher tax rate. More than one third of the sugarcane growers (36.00%) reported higher hire charges as constraints in using farm machinery. Only 10.00 per cent of the sugarcane growers reported inadequate hiring agencies and non availability of appropriate machinery for irrigation as constraints. All the sugarcane growers (100.00%) did not express any constraints for repairs, availability of service centers, availability of fuel bunks, in availing credit facilities, training in use of farm machinery and availability of farm machinery and equipments for field preparation.

Table 14: Correlation between independent variables and knowledge gap of sugarcane growers

Sl. no.	Variables	Knowledge gap
1	Age	-0.109 ^{NS}
2	Education	-0.019 ^{NS}
3	Land holding	-0.557**
4	Farming experience	
	a. In agriculture	-0.126 ^{NS}
	b. In sugarcane cultivation	-0.026 ^{NS}
5	Annual income	-0.002 ^{NS}
6	Farm resources	-0.220*
7	Cropping intensity	-0.710**
8	Innovativeness	-0.056 ^{NS}
9	Risk orientation	-0.017 ^{NS}
10	Extension contact	-0.350**
11	Mass media exposure	-0.334**

* Significant at 5%
** Significant at 1%
NS – Non-significant

Table 15: Correlation between independent variables and adoption gap of sugarcane growers

Sl. no.	Variables	Adoption gap
1	Age	-0.123 NS
2	Education	-0.057 NS
3	Land holding	-0.531**
4	Farming experience	
	a. In agriculture	-0.092 NS
	b. In sugarcane cultivation	-0.165*
5	Annual income	-0.055 NS
6	Farm resources	-0.071 NS
7	Cropping intensity	-0.115 NS
8	Innovativeness	-0.037 NS
9	Risk orientation	-0.055 NS
10	Extension contact	-0.078 NS
11	Mass media exposure	-0.334**

* Significant at 5%
** Significant at 1%
NS – Non-significant

Table 16: Constraints faced by sugarcane growers in farm mechanization

(n=150)

Sl. no	Constraints	F	%
1	High initial and maintenance cost	150	100
2	High fuel cost	150	100
3	Small and fragmented land holdings	150	100
4	Poor resale value of farm machinery and implements	120	80
5	Unsuitable and inappropriate farm machinery, implements and tools	120	80
6	High tax rate	112	74.67
7	High hire charges	54	36
8	Inadequate hiring agencies	15	10
9	Non-availability of farm machinery and implements:		
	a. Planting	150	100
	b. Earthing up	150	100
	c. Weeding	150	100
	d. Harvesting	150	100
	e. Irrigation	15	10
	f. Pest and disease management	14	9.33
	g. Field preparation	0	0
10	Frequent repairs	0	0
11	Non-availability of service centers and spare parts shops	0	0
12	Non-availability of fuel(petrol/diesel/oil) bunk locally	0	0
13	Lack of credit facilities	0	0
14	Non-availability of farm machinery	0	0
15	Lack of skilled labour to operate the farm machinery and implements	0	0
16	Lack of training on use of farm machinery, implements and tools	0	0

Drip irrigation being followed by a sugarcane grower

Tractor rotavator being operated in the respondents field.

Plate 1. Farm machinery used by sugarcane growers

Researcher interviewing highly mechanized sugarcane grower

Researcher with sugarcane growers

Plate 2. Researcher interviewing sugarcane farmer

Small and fragmented holdings

Dealy in harvest of sugarcane due to severe shortage of labour

Plate 3. Constraints faced by sugarcane farmers

Manual feeding of sugarcane into juice extractor

Manual filtration of sugarcane juice

Plate 4. Level of mechanization found in jaggary making units

5. DISCUSSION

The results of the study are discussed in the chapter under the following headings.

5.1 Profile of the sugarcane growers

5.2 Status of farm machinery and equipments possessed by sugarcane growers

5.3 Knowledge gap of the sugarcane growers of individual farm machinery and equipments and overall knowledge gap of the farm machinery and equipments of the sugarcane growers

5.4 Adoption gap of the sugarcane growers in use of individual farm machinery and equipments and overall adoption gap of the farm machinery and equipments of the sugarcane growers

5.5 Mechanization needs of sugarcane growers

5.6 Mechanization needs of sugarcane factories

5.7 Mechanization needs of jaggery making units

5.8 Factors contributing to knowledge gap of the sugarcane growers

5.9 Factors contributing to adoption gap of the sugarcane growers

5.10 Constraints faced by sugarcane growers in farm mechanization

5.1 Profile of the sugarcane growers

5.1.1 Age

The results presented in Table 1 and Fig. 2 revealed that majority (62.00%) of sugarcane growers belonged to middle age followed by old (25.33%) and a small proportion of farmers (12.67%) belonged to young age. One of the reasons for less number of young farmers is that farmers have become aware of importance of education and encouraging their children to go for higher education. They are also supported by good economic background for the cause. These results are line with the findings of Nagaraja (2002).

5.1.2 Education

It is clear from the study that 24.67 per cent of the sugarcane growers studied up to PUC followed by high school (22.67%), interestingly fairly equal number of the sugarcane growers studied up to middle school and graduation, while less number of sugarcane growers (17.33%) were illiterate. In recent past changes were observed in education level of rural India due to availability of proper educational facilities and better economic status to further continue higher studies. These results are contradictory with the findings of Chandrashekaran (1979) and Ghosh (2004)

5.1.3 Land holding

As the sample was stratified based on land holding we can see that equal proportion of farmers are distributed into small, medium and big farmers.

5.1.4 Farming experience

About 46.67 per cent the sugarcane growers belonged to low farming experience. This is because majority of the sugarcane growers belonged to middle age group. It is followed by high farming experience (29.33%) because 25.33 per cent of the sugarcane growers belonged to old age category. The results are contradictory with the findings of Lekshmi *et al*(2006)and Kumar(2009).

5.1.5 Experience in sugarcane cultivation

Majority of the sugarcane growers (48.67%) had low farming experience followed by high and medium as in the case of farming experience. This is because in the area selected for the study sugarcane is grown over several decades and thus no much deviation can be seen between farming experience and experience in sugarcane cultivation.

5.1.6 Annual income

Majority of the sugarcane growers (64.00%) belonged to high income level and only 13.33 per cent of the sugarcane growers had lower income level because, sugarcane is highly remunerative crop and yields are comparatively higher in the study area. Apart from these higher cropping intensity is seen due to availability of irrigation facilities. The results are contradictory with the findings of Babu (1990).

5.1.7 Farm resources

The results presented in table 1 depicts that 41.33 per cent of the farmers had low farm resources followed by 36.00 per cent in high farm resource category. This is because of availability of hiring facilities for use of various machineries. The findings are not in line with Shabnam (2011) where lower farm resource status was followed by medium level of farm resource category.

5.1.8 Cropping intensity

All the farmers had high cropping intensity since the area is well endowed with surface irrigation (canals) and supplementary irrigation by means of open wells and bore wells. The findings are in line with Ghosh (2004)

5.1.9 Extension contact

Table 1 and Fig. 2 show that nearly half of the sugarcane growers (49.33%) had low level of extension contact followed by 28.00 per cent who had higher extension contact. Majority of the sugarcane growers had low extension contact because the extension personnel fail to give expert advice to the farmer's problems. However, 28.00 per cent sugarcane growers had higher contact which may be due to different subsidy programmes in general which might have attracted or encouraged farmers to be in touch with the extension officials to avail various benefits.

5.1.10 Psychological attributes of the sugarcane growers

a. Innovative proneness

Table 2 and Fig. 3 also shows that 43.33 per cent of the sugarcane growers belonged to medium level of innovativeness and about 26.00 per cent had high level of innovativeness. Fairly high level of education may be the reason behind this. The results are in line with the findings Chandrasekaran (1979).

b. Risk orientation

Table 2 and Fig.3 also shows that almost 50.00 per cent of the population had medium level of risk orientation followed by 28.67 % of the sugarcane growers fall under high level of risk orientation. The possible reasons for this may be higher income level and fairly high level of education. The findings are not in line with the findings with Nagaraja (2002).

5.1.11 Extent of utilization of mass media by the sugarcane growers

It can be seen from the Table 3 that only 21.33 per cent of the sugarcane growers subscribed for newspaper. The major reason for this that they need to move to town to purchase the newspaper and about 20.00 per cent of the sugarcane growers had lower level education. Hardly 8.00 per cent of the sugarcane growers subscribed for agricultural magazines and regularly read agricultural articles. Majority of the sugarcane growers were not aware about agricultural magazines.

All most all the sugarcane growers did not possess radio but interestingly an overwhelming majority (99.33%) of the sugarcane growers possessed television. Majority of the sugarcane growers (78.00 %) could see agricultural programmes occasionally because of power cut during the broadcast of the programmes. Sugarcane growers felt that the time of broadcasting these programmes is convenient but the shift in power cut timing has made it inconvenient to watch the the agricultural programmes.

An overall view of mass media participation revealed that majority of the sugarcane growers (70.00%) belonged to low level of mass media participation followed by medium level accounting for 32.00 per cent. The possible reasons are non- availability of newspaper for sale at village level, low level of awareness about agricultural magazines and power cut during broadcast of agricultural programmes.

5.2 Status of farm machinery and equipments possessed by sugarcane growers

It can be seen from Table 5 that none of the farm machinery and equipments was owned by all the sugarcane growers except for sickle and spade because these are most essentially required farm tools irrespective of small, medium and big farmers. More than half of the sugarcane growers owned (58.00%) manual weeder as it is one of the most labour intensive stage in cultivation of any crop and its low cost. Despite of cent per cent knowledge, adoption gap was seen due to unsuitability of using it in stony lands.

Country plough was owned by 48.67 per cent of the sugarcane growers followed by 52.67 per cent power sprayer and 65.33 per cent knapsack sprayer which might be due to low cost of these tools, their utility for all the crops and their essentiality.

Further, 16.67 per cent of the sugarcane growers owned disc plough and heavy duty ridger followed by 13.33 per cent cultivator and 12.67 per cent tractor rotavator. Lower status is seen in these equipments because they are attachments to tractors and their cost is also high. It can also be seen from the table that none of the small farmers possessed these equipments but few medium farmers own these and lend them on hire basis.

It can also seen from the Table 9 that all most all the sugarcane growers own borewell and open well pump sets as sugarcane is an annual crop and surface irrigation (canals) is not available for all the seasons, therefore, supplementary irrigation is required.

Table 6 and Fig.5 shows overall distribution of sugarcane growers according to status of farm machinery and equipments. It can be clearly seen that maximum (46.00%) of the small farmers belonged to low farm machinery status. 36.00 per cent of the medium farmers had medium level of farm machinery status where as majority of big farmers (40.00%) had high level of farm machinery status. The results are in line with Dharmawardene and Krishnamurthi (1992).

5.3 Knowledge gap of the sugarcane growers of individual farm machinery and equipments

The results in Table 7 depict that there was no knowledge gap in the farm equipments used for field preparation. Moreover, all the sugarcane growers were also aware about spade, sickle, knapsack sprayer and power sprayer. The pattern of this gap indicates that the sugarcane growers had complete knowledge about traditional and conventionally used farm equipments.

Cent per cent of the sugarcane growers were not having any knowledge about machinery and equipments specifically meant for sugarcane cultivation viz., bullock drawn sugarcane planter, set cutter cum planter, sugarcane detrasher and whole stalk harvester except for sugarcane harvester in which knowledge gap was found to be just 15.33 per cent. The major reasons for this pattern of results is that these machineries specific to sugarcane cultivation are not promoted by any private firms or government agencies in the study area. Sugarcane growers are not even aware of the existence of these machinery and equipments. However, sugarcane harvester is exhibited in agricultural exhibitions and thus knowledge gap in its case is very less. Whole stalk harvester and sett cutter cum planter however is being promoted by sugar factories recently and due course of time will become aware of these machinery.

Knowledge gap is not seen even in drip and sprinkler technologies which may be due to efforts taken by both State Govt. of Agriculture and private companies to make it popular and availability of subsidies for adopting them. All the sugarcane growers were also aware about irrigation pump sets as they were basic and must for every farmer to have supplementary irrigation.

From Table 8 and Fig.6 it can be inferred that knowledge gap was slightly greater in case of small farmers followed by medium and big farmers. About half of small farmers had high knowledge gap and 40.00 per cent of big farmers had high knowledge gap. This is because of greater exposure of big farmers to farm machinery dealers.

5.4 Adoption gap sugarcane growers of individual farm machinery and equipments

Out of the identified 23 farm machinery and equipments, no adoption gap was seen in nine farm implements viz., country plough, disc plough, heavy duty ridger, spade, bore well, pump set, knapsack sprayer, power sprayer, sickle and tractor rotavator. This is followed by very little adoption gap in case of cultivator (10.00 %) and open well pump set (9.33 %). The remaining farm equipments were either less adopted or not adopted by the sugarcane growers except in the case of manual weeder where gap is 58.00 per cent followed by drip (68.67%) and sprinkler (77.33%).

It is inferred that adoption of field preparation equipment was in general high among the sugarcane growers. Plant protection equipments viz., knapsack sprayer and power sprayer were adopted by all the sugarcane growers besides the hand tools, spade and sickle.

This pattern of results is seen because adoption of field preparation equipment saves time and is also economical. Adoption of plant protection equipments and hand tools is cent per cent because they are must for practicing agriculture. Though everyone has knowledge about drip and sprinkler technologies all have not adopted these because of higher investment for drip in sugarcane, removal of drip sets during field preparation for next crop and non-suitability of sprinkler at later stages of sugarcane cultivation.

Table 10 and Fig.7 shows the overall distribution of the sugarcane growers based on adoption gap where 36 per cent of the small farmers had high adoption gap followed by 30.00 per cent among medium and 26.00 per cent among big farmers. The results are in line with Abid (2010)

5.5 Mechanization needs of sugarcane growers

Table 11and Fig. 8, 9,10 and 11 clearly indicates mechanization needs of sugarcane growers stagewise. It can be clearly seen cent per cent the farmers irrespective of small, medium and big felt that mechanization was most needed in weeding and harvesting operations. This is because manual labour has become very costly and moreover it is different to get labours at right time for both the operations and thus, resulting in greater loss of yield. Further majority of the sugarcane growers also expressed the shortcomings in existing machinery available for weeding and harvesting operations. Though many sugarcane growers have knowledge about power weeder, they do not adopt it because they reported problems such as spacing which was fixed and the blades were not strong enough to work under tough stony lands. They felt that if the weeder would be made adjustable for spacing's varying from 2 to 5 feet it would be more practical. They also expressed that if seating arrangement could be provided for the operator it would make the equipment even more convenient to use. Another drawback of this equipment was that it removes weeds only between the rows but the weeds between the plants had to be removed manually or using weedicides.

Thus, an innovation in this particular machinery can be made by fitting sprayers at the sides of power weeder so that weeding between the rows and applying weedicides between the plants can be made simultaneously, so that the process of weeding is completed at one stretch.

In the case of harvesting equipment and machinery all the farmers were dissatisfied with the existing imported harvesters. Due to small and fragmented land holdings, 4 to5 feet spacing is not economical for production. Thus, they felt the need of harvesters with 3 feet spacing. Another problem with these harvesters is that they cut the cane into small pieces and by the time the harvested cane reaches the sugar factories and get weighed there, considerable loss in the weight of the cane is found. The imported harvesters are very heavy and thus resulting in compaction of the field. The harvester as expressed by the sugar factories fail to operate in deep black soils in the beginning of the harvesting seasons due to

moisture higher content in the soil. In case of whole stalk harvester, which is an indigenous machine, the major problem is it lacks proper automation in loading. Another very important constraint among both the harvesters is that they do not harvest the lodged cane. But, as in the study area, cane grows at greater heights, the chances of lodging are greater and it is commonly seen. So, under this case farmer has to incur huge losses as the lodged cane gets wasted.

Further, as the farms in India are scattered and small, greater losses are increased during turning the machinery at the corner of the fields.

Farmer's prefer whole stalk harvester over the imported sugarcane harvester and there is the need to develop harvester which can harvest the lodged cane as well with automatic loading and preferably smaller and lighter in design.

All the sugar factories also expressed an urgent need for appropriate harvesters because harvesting of sugar cane is done by a particular tribe (Bedi tribe) from Maharastra and their number is almost constant but the number of sugar factories is continuously increasing and they are facing lots of shortage of these professional harvesting contract labours.

Majority of the sugarcane growers (85.33%) expressed that mechanization was most needed in planting of the cane because it is also one of the labour intensive operation and availability of labour was very difficult and the farmer had to pay them extra if planting was to be done at the night hours. For planting of sugarcane in traditional way irrigation is needed for planting the sets into the soil and irrigation in turn depends on power supply.

Farmer felt that if the sugarcane planter could perform multiple operations at stretch such as opening furrows, soil treatment, cutting the sett-treatment, fertilizer application, planting and covering the setts, it would make the machine more practical and feasible for use. The possible constraint that could arise in this machinery is the case of cutting setts, because the distance not only varies between one eye bud to another eye bud but also between one cane to another cane. This care should be taken while developing appropriate machinery to minimize the losses.

It can also be from table 10 that further mechanization in irrigation was needed as expressed by all most two-third of the sugarcane growers. Complete automation in the use of pump sets was needed by the sugarcane growers so as to avoid risk in operating them especially in rainy seasons. Drip irrigation for sugarcane crop is costlier, so developments of low drip system were expected by the growers.

Very few (12.67%) of the sugarcane growers felt that mechanization was also needed for earthing up operation as the machinery presently used for this operation further requires manual labour for completing the task.

Cent per cent of the sugarcane growers irrespective of small, medium and big farmers were completely satisfied with the farm machinery and equipments available for field preparation, pest and disease management and stubble removing operations.

Farmer also felt the need for a machine for detrashing of sugarcane (at farmer's field) as detrashing is also a labour intensive operation. Farmers also opined that if a single machine be able to do multiple works then would be more feasible.

5.6 Mechanization needs of sugar factories

It can be noticed from Table 12 that higher level of mechanization was seen in sugar factories and thus they reported very few mechanization needs. This is because sugar factories are larger firms and they import the technologies from elsewhere in the world and adopt them. However 50 per cent of the firms reported that there was need for complete automation in cane weighing and crushing followed by need for automation in sugar processing. Only 10 per cent of the units i.e., only one firm reported that mechanization in power generation were most needed because it had been recently set up.

5.7 Mechanization needs of jaggery making units

It can be depicted from Table 13 that cent per cent of the jaggery making units felt that mechanization was needed in juice extraction, filtration, cooling and packing.

In case of juice extraction the cane was manually put into the juice extractor and the crushed cane was manually shifted to an open area for drying which once dried was used for boiling the cane juice. Thus, here one can see no mechanization. It was reported by the units that, if some belt system was made so that the cane could move over it into the juice extractor and the crushed cane back through the belt into the driers, the operation would have been automised. But such system is not yet developed. Anyways, some firms have tried locally but failed to get exact results due to lack of expertise technically and scientifically.

Further, the units felt that there were mechanization needs in boiling and filtration as well. Open boiling is usually practiced by the unit which leads to lesser recovery. Thus, they felt the need for closed boiling. Another problem was reported that filtration of the boiled juice was made manually. Thus, automatic filtration facilitated by continuous movement of juice in the pans was most needed for which appropriate technology is not developed. Similarly, they also reported mechanization needs in cooling and packing as it required more timing. Overall complete automization technology for jaggery making units must be developed which is most needed by the jaggery making units.

Powder making mechanization need was not mentioned by the most of the firms but they felt that in future that it may become essential as well.

5.8 Association between personal characteristics and knowledge gap of the sugarcane growers

Out of 11 factors studied for their relationship with knowledge gap land holding, annual income, cropping intensity, extension contact and mass media exposure are negatively significant at one per cent level of significance, which implies as land holding, annual income, cropping intensity, extension contact and mass media exposure increases the knowledge gap of the sugarcane growers decreases. It can also be observed from the table that farm recourse is also significant negatively at 5 per cent level of significance. The possible reason for this is that as land holding increases the problem of labour shortage further increases and they have to depend largely on machinery for which farmers will be in constant touch with the input dealers to know about the farm machineries.

5.9 Association between personal characteristics and adoption gap of the sugarcane growers

The relationship between the independent variables and the adoption gap showed highly negative significant relation between land holding and adoption gap because as land holding increases the need for using the farm machinery also increases to perform timely operations and economise the production. The relation was also significant negatively between mass media exposure which implies that as mass media exposure increases adoption gap decreases. Farming experience in sugarcane cultivation is also negatively significant with adoption gap of the respondents.

5.10 Constraints faced by sugarcane growers in farm mechanization

There will be some factors which limit the use of any technology by the farmers. Therefore, in the use of improved farm machinery and equipments, farmers are expected to face problems. Hence, an attempt was made to know the constraints faced by the farmers. The information on this aspect is presented in Table 10. It reveals that all the sugarcane growers reported that high initial and maintenance cost, high fuel cost, small and fragmented land holdings and non availability of farm machinery and implements for planting, earthing up, weeding and harvesting were the major constraints followed by poor resale value of the farm machinery (80%).

Majority of the sugarcane growers (74.67%) also felt that the tax rates were high while the remaining farmers were not aware about the tax that they were paying. Only 36 per cent of the farmers felt that the hire charges were high and rest did not feel so because the wages of the labours are increasing and hiring in machines is more feasible.

6. SUMMARY AND CONCLUSION

Agriculture is the most important sector of the Indian economy. Most of the farming in India is carried out on small holdings. Since, the level of agricultural mechanization in India is relatively low with only 10 per cent of Indian farms tractor powered, draught animals and farm labour are the important sources of farm power. Agricultural machinery and equipments are not only capable of doing field operations consuming less time and with better quality, but also enable rapid adoption of other technological innovations. However, mechanization possibilities are strongly being influenced by farm size, cost of farm labour, availability of machines and energy. In this background this study was formulated with the following objectives:

1. To document the status of mechanization in sugarcane cultivation.
2. To identify the gaps in knowledge and adoption of improved farm implements in sugarcane cultivation.
3. To document the constraints in use of farm implements.
4. To map the mechanization needs of sugarcane growers.

The study was an "expost-facto" research carried out in Belgaum district of Karnataka. The study was mainly based on primary data collected from the sample farmers selected through stratified random sampling method. Athani, Raibag, Gokak, Chikkodi and Hukkeri talukas were selected since they had maximum area under sugarcane cultivation. From each taluka two villages were randomly selected out of which 15 farmers were randomly selected from each village forming a sample size of 150 farmers. Also 10 sugar factories and jaggery units were also surveyed to know their mechanization needs.

Major findings:

1. Majority of the sugarcane growers (62.00%) belonged to middle age followed by old age category (25.33%) and 12.67 per cent belonged to young age category. Higher proportion of the sugarcane growers (24.67%) studied up to PUC level and 16.00 per cent of the sugarcane growers were graduates.
2. Nearly half of the sugarcane growers (46.67%) belonged to low farming experience and 48.67 per cent of the sugarcane growers had low experience in sugarcane cultivation. As high as 64.00 per cent of the sugarcane growers had high annual income and 41.00 per cent of the sugarcane growers belonged to low farm resource category.
3. All the sugarcane growers (100%) had high cropping intensity. Slightly less than half of the sugarcane growers (49.33%) had low extension contact and 46.67 per cent of the sugarcane growers had low mass media participation.
4. Less than half of the sugarcane growers (43.35%) belonged to medium category of innovativeness and slightly less than half of the sugarcane growers (49.33%) had medium level of risk taking ability.
5. Majority of the sugarcane growers (83.33%) hired disk plough and heavy duty ridger, which implies that only 16.67 per cent of the sugarcane growers owned these implements. Majority (73.33%) of the sugarcane growers hired cultivator.
6. Cent per cent the sugarcane growers owned spade, sickle and bore well pump sets. Less than half of the sugarcane growers (48.67%) owned country plough. Slightly greater than half of the sugarcane growers (52.67%) owned power sprayer. Only 12.67 per cent of the sugarcane growers owned tractor rotavator.
7. Majority of the sugarcane growers (90.66%) owned open well pump sets. Drip and sprinkler were owned by 31.3 per cent and 22.66 per cent sugarcane growers respectively. Manual weeder was owned by 42.00 per cent of the sugarcane growers.
8. Forty per cent of big farmers had high status of farm machinery. Forty six per cent of the small farmers had low status while 36 per cent of the medium farmers had medium level of status.

9. Cent per cent the sugarcane growers did not had any knowledge of irrigation channel former, bullock drawn sugarcane planter, sugarcane detrasher and whole stalk harvester. However cent per cent of the sugarcane growers had knowledge about land preparation equipment viz., country plough, disk plough heavy duty rider tractor rotavator and plant protection equipments namely knapsack, sprayer and power sprayer. In addition to this, knowledge gap was nil in sprinkler and drip technologies. Hand tools viz., sickle and spade were known by all the sugarcane growers.
10. Majority of the sugarcane growers did not possess knowledge about boom sprayer (88.00%) and power weeder (61.33%). Only 15.33 per cent sugarcane growers did not have knowledge about sugarcane harvester and knowledge gap in power tiller rotavator was just 12.00 per cent.
11. Half of the small farmers (50.00%) belonged to high knowledge gap category while followed by 44.00 per cent of medium farmers and 40.00 per cent of big farmers had high knowledge gap about farm machinery and equipments.
12. There was 100 per cent adoption gap seen in use of bund former, irrigation channel former, bullock drawn sugarcane planter, set cutter cum planter, sugarcane detrasher, whole stalk harvester and sugarcane harvester. A very higher majority of the sugarcane growers (99.33%, 96.67% and 92.00%) did not use power weeder, boom sprayer and power tiller rotavator respectively.
13. More than half of the sugarcane growers 68.67 per cent adopted drip irrigation technology and slightly greater 77.33 per cent of the sugarcane growers did not adopt sprinkler technology. Only 9.33 per cent of the sugarcane growers did not adopt open well pump sets and 10 per cent gap was seen in adoption of cultivator.
14. All the sugarcane growers (100%) adopted country plough, disk plough, heavy duty ridger knapsack sprayer, power sprayer, spade and sickle.
15. About 36.00 per cent of small farmers belonged to high adoption gap category while 30.00 per cent among medium farmers and even lesser (26.00%) among the big farmers belonged to higher adoption gap category.
16. Cent per cent of the sugarcane growers irrespective of small, medium, and big farmers expressed that mechanization was most needed in weeding, harvesting and planting operations. About 64.00 per cent of the sugarcane growers felt that further mechanization in irrigation is needed.
17. Cent per cent of the farmers were satisfied with the machinery and equipments available for field operation, pest and disease management and stubble removing.
18. Fifty per cent of the sugar factory units expressed that there is a need for mechanization in cane weighing and crushing while 30 per cent reported needs for mechanization in sugar processing.
19. Cent per cent of the jaggery making units reported that mechanization was needed at four important stages viz., juice extraction, filtration, cooling and packing at present but need may arise for mechanization in powder making in future.
20. Knowledge gap among the sugarcane growers had negative and highly significant relationship with land holding, annual income, cropping intensity, extension contact and mass media participation. The variable farm resource is also negatively significant with knowledge gap but variables like age, education, farming experience, innovativeness and risk orientation were non-significant.
21. Adoption gap among the sugarcane growers had negative and highly significant relationship with land holding and mass media exposure and negatively significant with farming experience in sugarcane cultivation. Majority of the variables like age, education, land holding, experience in agriculture ,annual income, farm resources, cropping intensity, innovativeness, risk orientation and extension contact are non-significant.
22. Cent per cent of the farmers reported that high initial and maintenance cost, high fuel cost, small and fragmented land holdings, non availability of farm machinery and implements for planting, earthing up, weeding and harvesting were the major constraints faced by sugarcane growers. Majority of the sugarcane growers (80.00% and 74.67%) reported that poor resale value of the farmer and high tax rate as the constraints.

Implications of the study:

1. Majority of the farmers possess only traditional equipments and very few farmers possess cultivator, disk plough and heavy duty ridger, and rotavator due to high initial investment involved. Majority of small and medium farmers use these equipments on hire basis which calls for the need for introducing appropriate subsidy scheme by Govt. of India along with establishment of hiring centres at RSK's which must also include sugarcane specific machinery like sett cutter cum planters and sugarcane harvesters.
2. It is noticed that the knowledge level of the sugarcane growers is nil about sugarcane machinery except for sugarcane harvester. Therefore, in the interest of enhancing farm mechanization in sugarcane cultivation, these farm machinery and equipments need to be promoted on a larger scale and in an intensive manner by the College of Agricultural Engineering and private firms as well. This would also lead to greater adoption of these farm machinery and equipments.
3. It is observed that though knowledge on drip and sprinkler irrigation was very high their adoption was found to be low. Therefore, awareness on credit facilities and subsidy components need to be created among the farmers to enable them adopt mechanized irrigation systems. In order to mechanize all the operations, there is a need to encourage subsurface drip irrigation instead of surface drip irrigation by the staff of State Department of Agriculture.
4. Cent per cent of the farmers felt that mechanization was most needed in weeding and harvesting operations but were not satisfied with the existing machinery. This calls for development of weeders and harvesters suitable to Indian conditions. Majority of the farmers also reported mechanization need for planting of sugarcane for which appropriate sett cutter cum planter should be developed suitable to local conditions.
5. It can be noticed from the results that cent per cent of the jaggery making units need their units to be mechanized in juice extraction, filtration, cooling and packing but lack appropriate technology. Thus, research should be carried out to come out with appropriate mechanization technology in all these operations to overcome the drudgery in jaggery making units.

Future line of work:

1. This study can be taken up in other districts also in order to get a comprehensive picture about farm machinery needs of the farmers and even for other crops.
2. In-depth analysis of the constraints expressed by the sugarcane growers can be taken up in order to find out practical solutions for each problem.
3. A study can be conducted to know the opinion of farmers about introduction of highly advanced mechanization technologies including GIS and remote sensing in Indian agriculture.

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APPENDIX I

Farm machinery and equipments included for knowledge test

1.	Country plough
2.	Bund former
3.	Cultivator
4.	Disc plough
5.	Heavy duty ridger
6.	Irrigation channel former
7.	Bullock drawn sugarcane planter
8.	Set cutter cum planter
9.	Spade
10.	Power weeder
11.	Manual weeder
12.	Drip irrigation
13.	Sprinkler irrigation
14.	Pump set
	a. Open well
	b. Bore well
15.	Knapsack sprayer
16.	Boom sprayer
17.	Power sprayer
18.	Sickle
19.	Sugarcane detrasher
20.	Whole stalk harvester
21.	Sugarcane harvester
22.	Power tiller rotavator
23.	Tractor rotavator

APPENDIX II

Interview schedule

Mechanization needs of sugarcane growers in Belgaum district

Respondent no.:_____

PART-A

A. General information

1. Name of the respondent : _____

2. Village : _____

3. Taluk : _____

4. District : _____

B. Profile of the respondent

1. Age : _____years

2. Education : _____

3. Land holding (in acres)

a) Dry land:_____

b) Irrigated: _____

Total : _____

4. Farming experience (in years)

a) Since how many years are you actively engaged in agriculture?

_____

b) From how many years are you cultivating sugarcane?

_____

5. Farm Resources

Resource	Type of soil/irrigation source/livestock	Area /No.
Land /soil type	Black	
	Red	
Water	Irrigated	
	Rainfed	
Livestock	Drought	
	Milking(buffalo/cow)	
	Sheep /goat	
	Poultry birds	
	Any other specify	
Material possession	1. Plough	
	2. Bullock cart	
	3. Tractor	
	4.Other equipments	

6. Cropping intensity:

Sl. No.	Season	Crops grown and acreages			
		Dry land	Acres	Irrigated	Acres
1.	Kharif				
2.	Rabi				
3.	Summer				

7. Innovativeness

Sl. No.	Statements	Responses	
		Most like	Least like
1.a	I try to keep myself up to date with information on new farm practices, but that does not mean that I try out all new methods on my farm		
b.	I feel restless till I try out a new farm practice, that I have heard about		
c.	They talk of many new farm practice these days, but who knows if they are better then old ones		
2.a.	From time to time I have heard of several new farm practices and I have tried out most of them in the last few years		
b.	I usually wait to see what results my neighbors obtain before I try out the new farm practices		
c	Some how I believe that traditional ways of the farming are the best		
3.a	I am cautious about trying a new practice		
b.	After all our forefathers were wise in their farming practices and I do not see any reason for changing these old methods		
c.	Often new practices are not successful, however, if they are promising I would surely like to adopt them		

8. Risk Orientation

Sl. No.	Statements	SA	A	UD	DA	SDA
1.	A farmer should grow more number of crops to avoid greater risk involved in growing one or two crops					
2.	A farmer should take more of chance in making a big profit than to be content with a smaller, best less risky profits					
3.	A farmer who is willing to take greater risks than the average farmer actually does better financially					
4.	It is good for a farmer not to take risk when he knows his chance of success is fairly high					
5.	It is better for a farmer not to try new farming methods unless most other farmers have used it with success					
6.	Trying an entirely new method in farming by a farmer involves risk but it is worth					

9. Extension contact :

Sl.No.	Extension agents	Frequency of contact			
		Once in a week	Once in fortnight	When needed	Never
1.	AAO				
2.	AO				
3.	ADA				
4.	University scientists				
5.	Private company field staff				
6.	Agril. Engineering staff				
7.	Input dealers				
8.	Others specify				
	a.				
	b.				

10. Mass media exposure:

Please indicate the extent of use of different mass media

Sl. No.	Media	Owned/ others	Type of content you read/listen/ watch	Reading/hearing/viewing behavior		
				Regular	occasionally	Never
1	News paper		a. General news			
			b. Agricultural news			
2	Agricultural magazines/journals		a. general magazines b. agricultural magazines			
3	Radio		a. General programmes			
			b. Agricultural programmes			
4	T. V.		a. General programmes			
			b. Agricultural programmes			

PART-B

Status , knowledge and adoption of farm machinery and equipments in sugarcane cultivation

Sl no.	Farm equipments	Knowledge		Adoption		Own		Hire
		Yes	No	Yes	No		Nos.	
1.	Country plough							
2.	Bund former							
3.	Cultivator							
4.	Disc plough							
5.	Heavy duty ridger							
6.	Irrigation channel former							
7.	Bullock drawn sugarcane planter							
8.	Set cutter cum planter							
9.	Spade							
10.	Power weeder							
11.	Manual weeder							
12.	Drip irrigation							
13.	Sprinkler irrigation							
14.	Pump set							
	a. Open well							
	b. Bore well							
15.	Knapsack sprayer							
16.	Boom sprayer							
17.	Power sprayer							
18.	Sickle							
19.	Sugarcane detrasher							
20.	Whole stalk harvester							
21.	Sugarcane harvester							
22.	Power tiller rotavator							
23.	Tractor rotavator							

PART –C

Mechanization needs (Sugarcane growers)

Do you need introduction of new farm machinery? (Yes/no)

If yes under what stages of cultivation?

Sl.no	Stages	Priority	Machines	Most needed	Needed	Less needed
1.	Field preparation					
2.	Planting					
3.	Earthing up					
4.	Weeding					
5.	Irrigation					
6.	Pest and disease management					
7.	Harvesting					
8.	Stubble removing					

Do you need changes in existing farm machinery? (yes/no)

If yes in which equipments?

Sl. No.	Equipments	Problems	What changes needed			
			Operation	Cost	Capacity	Power source
1.	Country plough					
2.	Bund former					
3.	Cultivator					
4.	Disc plough					
5.	Heavy duty ridger					
6.	Irrigation channel former					
7.	Bullock drawn sugarcane planter					
8.	Set cutter cum planter					
9.	Spade					
10.	Power weeder					
11.	Manual weeder					
12.	Drip irrigation					
13.	Sprinkler irrigation					

Sl. No.	Equipments	Problems	What changes needed			
			Operation	Cost	Capacity	Power source
14.	Pump set					
	a. Open well					
	b. Bore well					
15. 16. 17.	Knapsack sprayer					
	Boom sprayer					
	Power sprayer					
18.	Sickle					
19.	Sugarcane detrasher					
20.	Whole stalk harvester					
21.	Sugarcane harvester					
22.	Power tiller rotavator					
23.	Tractor rotavator					

What other suggestion do you provide for better mechanization development in sugarcane?

_____
_____
_____
_____
_____

PART-D

Constraints faced by sugarcane growers in farm mechanization

Sl.No.	Constraints	Yes	No
1.	High initial and maintenance cost		
2.	Frequent repairs		
3.	Non-availability of service centers and spare parts shops		
4.	Low resale value of farm machinery and equipments		
5.	Non-availability of fuel bunk locally		
6.	High fuel cost		
7.	High tax rate		
8.	Lack of credit facilities		
9.	Non-availability of farm machinery, equipments and tools		
10.	Unsuitable / inappropriate farm machinery, equipments and tools		
11.	Inadequate hiring agencies		
12.	High hire charges		
13.	Lack of skilled labour to operate the farm machinery and equipments		
14.	Small and fragmented land holdings		
15.	Lack of training on use of farm machinery, equipments and tools		
16.	Non-availability of farm machinery and equipments:		
	a. Field preparation		
	b. Planting		
	c. Earthing up		
	d. Weeding		
	e. Irrigation		
	f. Pest and disease management		
	g. Harvesting		
15.	Unsuitable/inappropriate farm machinery and equipments		
	a. Field preparation		
	b. Planting		
	c. Earthing up		
	d. Weeding		
	e. Irrigation		
	f. Pest and disease management		
	g. Harvesting		

MECHANIZATION NEEDS OF SUGAR INDUSTRY

Do you need introduction of new farm machinery?(yes/no).if yes under what stages?

Sl.no	Stages	Priority	Machines	Most needed	Needed	Less needed
1.	Cane weighing and crushing					
2.	Boiling					
3.	Power generation					
4.	Sugar processing					

Do you need changes in existing farm machinery? (yes/no)

If yes in which machinery?

Sl. No.	Machines	Problems	What changes needed			
			Operation	Cost	Capacity	Power source
1.	Weigh bridges					
2.	Sugarcane mills					
3.	Pressures feeders					
4.	Heavy duty shredder					
5.	Fibrizer					
6.	Rotary screens					
7.	Boilers					
8.	Steam turbine generators					
9.	Juice heators					
10.	Evaporators					
11.	Vaccum pans					
12.	Crystalizers					
13.	Centrifugal machine					

PART-E

Mechanization needs of jiggery making units:

Do you need introduction of new farm machinery? (yes/no)

If yes under what stages of production?

Sl. no	Stages	Priority	Machines	Most needed	Needed	Less needed
1.	Juice extraction					
2.	Filtration and boiling					
3.	Cooling and packing					
4.	Powder making					

Do you need changes in existing farm machinery? (yes/no)

If yes in which machinery?

Sl. No.	Machines	Problems	What changes needed			
			Operation	Cost	Capacity	Power source
1.	Sugarcane crusher					
2.	Juice storage tanks					
3.	Iron pans					
4.	Weighing bridge					
5.	Iron scrapers					
6.	Any others					

MECHANIZATION NEEDS OF SUGARCANE GROWERS IN BELGAUM DISTRICT

TASKEEN M. DANGE **2012** **DR. J. G. ANGADI**
MAJOR ADVISOR

ABSTRACT

The present study was conducted during 2011-12 in Belgaum district of Karnataka state to map the mechanization needs of sugarcane growers. The sample for the study consisted of 150 sugarcane growers, 10 sugar factories and 10 jaggery units. The data was collected by personal interview method.

Forty per cent of big farmers belonged to high status of farm mechanization while 46.00 per cent of the small farmers had low status and 36.00 per cent of the medium farmers belonged to medium status category. Half of the small farmers (50.00%) had high knowledge gap about farm machinery and equipments followed by 44.00 per cent of medium farmers and 40.00 per cent of big farmers, respectively. Nearly 36.00 per cent of small farmers belonged to high adoption gap category and 26.00 per cent adoption gap was found among the big farmers. Cent per cent of the sugarcane growers expressed that mechanization was most needed in weeding, harvesting and planting operations and 64.00 per cent of the sugarcane growers felt that further mechanization in irrigation is needed. Fifty per cent of the sugar factory units expressed need for mechanization in cane weighing and crushing and cent per cent of the jaggery making units reported that mechanization was needed in juice extraction, filtration, cooling and packing.

All the farmers reported that high initial and maintenance cost, high fuel cost, small and fragmented land holdings, non availability of farm machinery for planting, earthing up, weeding and harvesting were the major constraints in mechanizing sugarcane cultivation. Land holding, annual income, cropping intensity, extension contact, mass media participation and farm resource were found to be negatively significant with knowledge gap while land holding, mass media exposure and farming experience in sugarcane cultivation were found to be negatively and significantly associated with adoption gap of sugarcane growers.