I. Executive summary:

Jaggery is a traditional, concentrated product of cane juice without separation of the molasses and crystals and varies from golden brown to dark brown in colour (FAO). Jaggery industry is one of the largest agro – based cottage industries, managed by unorganized sector in India. Prior to twentieth century, entire sugarcane was utilized for jaggery and Khandsari production. This cottage industry remains neglected due to adoption of traditional system of sugarcane crushing, juice clarification, heating, boiling without any suitable technological advancement. Lack of Government policy and a meagre financial support from financial institution add to the vows of the industry.

Jaggery production depends on various factors such as cane price arrears paid by sugar mills during previous crushing season, profitability and solvency status, beginning of crushing operation of sugar mills, sugarcane price fixation, supply – demand scenario during early crushing phase and jaggery product price and demand scenario in local market.

The factors responsible for rapid down fall of jaggery sector were poor technological interventions for juice extraction, heat utilization, furnace inefficiency, jaggery storage and packaging, quality control interventions due to paucity of infrastructural development funds and inadequate extension supportive mechanism. Therefore, it is very much essential to revive the jaggery processing sector to safeguard the economic interest, minimize dependence on sugar mills, of millions of sugar cane farmers and rural workers for their livelihood security and prosperity besides prevention of migration.

In light of the above facts, the state government has financially supported setting up of a jaggery park under the jurisdiction of university of agricultural Science, Bangalore. The main objective of the jaggery park is to cater to the needs of jaggery farmers through technological innovations and dissemination of information on all spear heads of chemical free jaggery preparation during the years 2008-11 with a financial out lay of about Rs. 8 Crores.

As on date, the center has developed sugar rich variety VCF 0517 besides have screened several verities like Co86032, Co62175, etc, suitable for jaggery processing. The center has so far developed and standardized different agronomical practices viz wider spacing, drip irrigation, INM, IPDM management techniques, intercropping and farm

mechanization. However, these technologies though highly beneficial and profitable in enhancing the yield and quality of cane suitable for jaggery processing, their spread or acceptance by the farmers is only to the tune of 15-20 per cent and there is a gap of 80-85 per cent. It is notable that the spread of variety VCF 0517 is very good and is fast spreading but still there is gap of 65-75 per cent.

The centre has created an opportunity for more scientific method of chemical free jaggery processing techniques for meeting the demands of growing population compared to chemically processed jaggery, which is not suitable for human consumption. But still, there is a greater demand in the market for chemical jaggery only because of its bright colour. While the chemical free jaggery is dull and golden brown colour, has no demand, on the contrary is priced higher because it has a selective buyers as it has high nutricical and medicinal value for human and also for animals consumption. The entire traders know the ill effects of chemical jaggery on Human health, they have failed to push the sale of the product i.e., chemical free jaggery only because of colour. Hence, there is a need for government intervention to ban the processing of chemical jaggery in the state of Karnataka keeping in view the health of the consumer.

The park has provided more importance on processing of the chemical free jaggery for its potential nutritional status and hygiene in processing of jaggery, which do fetch competitive price both in local and international markets which in turn facilitates to earn higher foreign exchange. The park scientists have extensively trained about 141 farmers and broadcasted 12 All India Radio Programmes in the area of sugarcane cultivation (Agro-technique) post-harvest management of cane, juice extraction, processing of juice and hygienic jaggery processing without chemicals which has adequate demand from the farmers from almost all Taluks of Mandya district. However, the acceptance of Agro - techniques are highly encouraging as the majority of the farmers have seen the benefits of technology but they are slow moving. On the contrary, they have been well educated on the improved method of processing chemical free jaggery. Further, the acceptance of the technological innovations, starting from extraction, use of herbal clarificants, modernized and fuel efficient furnace, steel boiling pans to prevent caramalization, cooling pits with granite slab flooring and steel moulds etc,. Though accepted the benefit of these technologies their adoption is very low because of infrastructure development cost is very high.

Besides, they have also imparted training to departmental officials, college students and Farmers (1500) of southern Karnataka on all aspects of sugar cane cultivation for chemical free jaggery processing.

The Steam boiling unit (Fig -5.18.1) established recently for processing of chemical free jaggery at a cost of about Rs. 35 lakhs is yet to be standardized for processing of jaggery. The scientists of Jaggery Park should immediately should standardize and activate at the earliest without any further delay for its utility for the betterment of farming community, which is a unique one in processing high quality jaggery in meeting the international standards besides fuel efficiency (20%) and labour efficiency (50%).

The park has initiated a process of popularizing the chemical free jaggery technology through public private partnership (PPP) model. It is a good effort in right direction, for utilizing the infrastructure created by Government of Karnataka for the benefit of jaggery farmers as well as growing population for providing sweetener. However, the project is still at infancy and needs more time to assess the impact of such a model, because of three years consecutive drought in Cauvery command area leading to drop in production and productivity of sugarcane.

As of today, the existence of park is highly relevant to Mandya because of following reasons viz., consequent to urbanization and industrialization of Cauvery command area, unstabilized market for cereals, pulses and vegetables leading to indebtedness of the farming community besides non availability of farm labour and erratic electricity supply, the farmers have shifted from cultivation of food crops to a commercial crop like sugarcane in order to improve their economic status and livelihood security. Consequent of non-availability of improved technology in the field of sugarcane research and jaggery processing to the farming community, the jaggery processing and production has comedown drastically. Therefore, this is the only institute specifically meant for carrying out above said research. In addition, the park has a potential to develop appropriate Standard technologies to harness off seasonal jaggery processing in the Cauvery Command area which is unique in entire Southern Plateau and needs to be enchased.

The jaggery park established by UAS (Dharwad) at Mudhol and Sankeshwar are the replica of jaggery park of Mandya. The technological interventions and dissemination made

by this center with regards to sugarcane varieties, agro techniques to enhance sugar recovery and cane yield, farm mechanization and exportable organic jaggery processing techniques have been ably demonstrated to the farming community of Northern Karnataka. The public private partnership (PPP) Model adopted at Mudhol is also a good model and continued its growth as long as was supported by RKVY funding (Subsidy). No sooner, the RKVY support was withdrawn, the progress of the PPP model has come to stand still or moving at a low profile.

The park at Mudhol and Sankeshwar, though have developed good Agro-techniques, the adoptability of the technology by the stake holder is only to the tune of 15-20 per cent except the technology of organic jaggery processing which has been scaled up not only in meeting the local needs and demand but also resulted in increased exportability of organically processed jaggery to many countries. Here too, the park has inadequacy of technical manpower in respect of jaggery processing and post-harvest management which was observed during our visit to the park which was managed by only 2 semi-skilled field assistants who did not have any required qualification on the issue relating to organic jaggery processing and post-harvest management on scientific basis, but with only mear experiences and observations of the skilled labour . Hence, there is need for rejenuvating the activities at the earliest by the university authorities for benefits of farming community of Northern Karnataka.

The survey information compiled reveals that (more than 50%) of farmers are small and marginal with land holding of 5 acres and 90% of them are living in Kaccha houses, almost all the farmers are well aware of the suitability of soil for cultivating sugar cane. They grow sugarcane and supplied to jaggery units because they get quicker and high price for sugarcane than sugar factories. Further, they have also expressed that the area of sugarcane cultivation though did not increased due to training program undergone by the farmers at park but there was a definite and significant improvement in the productivity of sugarcane. However, more than 50% of the farmers have expressed their dissatisfaction for non-availability of soil testing facilities at Jaggery Park, though the jaggery park has the excellent laboratory facilities established by utilizing RKVY fund for soil, sugarcane, and jaggery. About 63% of the farmers they stated that they select the verity, fertilizer application and chemicals based on their own experiences and only about 11% carry out scientific method of

sugarcane cultivation, indicating a gap in extension. More so training on sugarcane cultivation, jaggery processing in context of today's demand.

It is a well-known fact that the jaggery quality is also dependant on sugarcane verities they cultivate and the survey has revealed that verity Co 62175, Co86032, are the best verities with regard to tonnage and jaggery recovery. A sugar rich verity which has both tonnage as well as highest sucrose which is being forcefully recommended as a high potential for cultivation of this verity. As on today only (16%) the farmers have adopted this technology and needs to be up scaled as the earliest.

About 65% of the farmers have expressed that they are in need of financial assistance for cultivation of sugarcane. Further, it is known that 60% of the farmers transport the cane to the jaggery units through bullock carts leading to tonnage loss deturation in Juice quality and poor recovery, these needs to be looked into.

In principle, the juice extraction processing, furnace, chimney, boiling pans and moulding units play a phenomenon role in jaggery quality and yield. It is about 95-98% of jaggery processors do not possess any improved equipments of jaggery processing and are out-dated models and unhygienic. Hence, there is a greater and urgent need for modernization of scientific chemical free jaggery processing, should be the one of the mandate of Industries and Commerce Department besides, Agriculture Department.

The juice requires clarificants agents to get colour, crystallize structure, hardness, hygienic jaggery. The same can be obtained by using organic clarificants and calcium (Annexure) on the contrary it is observed that the processors are using chemical clarificants though not recommended at a particular level wherever necessary (Annexure) but are being used liberally or indiscriminately only to get the bright colour for which there is a market demand. Besides, 93% processors are also using industrial chemicals **(Sodium Formaldehyde Sulphoxylate (Sulpholite/decolite)** an industrial textile bleaching agent (Annexure. 4) for bleaching the jaggery which has quick disposal in the market but it is highly deterimental to the health of the consumer and should be banned with immediate effect.

The study also revealed that both the institutes (UAS B and (UAS D) have not made much progress with regard to diversifying the jaggery products except restricting themselves

to three major products like jaggery solid, liquid and powder forms. However, the diversified product of jaggery has great potential for export, the outcome of these institutes are not proportionate to the amount spent on research.

About 54 per cent of the consumer are employed and 30 per cent are agriculturist almost all the consumers are well aware of the knowledge on chemical free jaggery but preferred to buy the chemically processed jaggery because its price is low in the market besides it has attractive bright colour, which is not desirable in health point of view in addition they have also revealed that they know only one type of jaggery i.e. solid jaggery but not the other forms jaggery (Liquid and powder) indicating a gap in transfer of knowledge to the consumer by the jaggery park Scientists in the study area. Further, it is not worthy to state that on an average 10 to 20 kg of jaggery is consumed in a year by spending of Rs. 500-1000 annually which indicates a good market potential.

Hence, it is essential to modernize and to develop organic clarificants ready to use vegetable clarificants for quality of jaggery production to meet the consumer demand, export potential and health.

It was observed that jaggery is marketed in APMC yard, Mandya, is exclusively meant for disposing jaggery. The APMC yard is monopolized by traders and middlemen. As of today, there is no exclusive market for chemical free jaggery. The jaggery is being disposed based on colour and not on quality parameters. However, there exists a better scope if a separate provision is made for chemical free jaggery which is having high sucrose besides medicinal value, keeping quality and export potential. The same was expressed by the traders (**95%**) themselves. To encourage this, there is need for e-marketing, though this system was introduced earlier, the concept has been withdrawn with greater protest from the traders as it was evident during the survey. The traders (**90%**) are also well aware of the ill effects of chemical jaggery and they too encourage chemical free jaggery but for the consumer's preference for bleached white colour jaggery rather than golden yellow colour of chemical free jaggery.

The socio-economic impact of jaggery cottage industry may not be ruled out easily because of its contribution in rural development and monitory benefits to cane farmers. It is a

labour intensive cottage entrepreneurship managed by semi and skilled workers at cheaper wages, providing employment avenues to number of rural workers and also restricts urban migration. The growers may harvest sugarcane crop as per their own convenience for its supply to jaggery units, get early payment and plan for next crops. If cane farmer are willing to supply it to sugar mills they depend on cane supply indent availability (cutting order). On the other hand they get payment immediately for cane supply to jaggery units. This cottage industry does not require sophisticated technologies as it uses indigenous processing equipment. They make diversified products such as solid jaggery, liquid jaggery and powder jaggery as per market demand and price by utilizing same machinery. The jaggery product helps in fulfilling the food and nutritional requirements in rural areas. Hence, it is paramount to develop efficient techniques for modernization of jaggery as a cottage industry to make them economical and profitable enterprises to face monopolistic challenges of sugar lobby and safeguard interests of millions of cane farmers.

Technological innovations for resurgence of jaggery would definitely have to go a long way in strengthening rural economy. Its resurgence would be essential for minimizing sweetener sole dependency on white sugar production. Besides, it is growing awareness amongst the consumers towards nutritious food items in our society which may reverse the currently rising trend of sweetener consumption in the form of refined sugar and declining trend in jaggery demand. Its creativity processing, hygiene, quality control, innovative packaging and storage may have some momentum and open additional income and employment avenues to rural youth. The technological advancement in juice recovery, heating and organic clarificants has scope for improving the efficiencies and address the issues of optimal by products utilization.

Table 01: Evaluation questions and sub questions:

SI	***Evaluation questions (Inclusive and not exhaustive):***	***Findings***
1.	Has the chemical free Jaggery preparation unit, the Jaggery Park V.C. Farm, Mandya and the trainings provided by it in making chemical free Jaggery made any impact on Jaggery unit owners, APMC Merchants and consumers with regards to going in for only chemical free Jaggery production, Marketing and consumption?	**Yes.** About 95% of traders state that chemical free jaggery though dull in colour, tastes good while chemically processed jaggery is having salty with lesser sweetness besides sulphur smell and poor keeping quality.
2	Are the Jaggery sellers and its consumers aware about the fact that chemicals are used in making Jaggery? Are they aware of the chemicals used and/or its ill effects on human health?	Jaggery sellers know the fact of liberal use of chemicals during the processing of jaggery to impart white colour which is market driven. While majority of consumers do not know about the use of harmful chemicals in processing of jaggery. The traders are fully aware of ill effects of chemicals used in jaggery processing. On the contrary the consumers do not know the ill effects of chemically processed jaggery thus, there is an urgent need to bring awareness to the public through mass media. (Doora Dharshan, All India Radio, News Paper etc.)
3	Does chemical free Jaggery have a different taste or appearance than usual Jaggery prepared with the usage of chemicals? (perception of Jaggery users may be used to answer this)	Yes. Chemical free jaggery taste is liked by the consumers which has good taste but dull golden colour which do not attract the consumers but still fetches higher price in the select markets compared to chemically processed jaggery which has attractive white colour with high demand in APMC market in spite of its ill effects on human health.
4	Are the Jaggery sellers and its consumers paying or willing to pay a higher price for chemical free Jaggery? If no, why not? If yes, what percentage more than the price of usual Jaggery are they paying, and what is the scope further in willingness to pay, for	**Yes.** Both sellers and consumers are ready to pay higher price for chemical free jaggery because of its chemical free nature, high quality, taste and keeping quality. On the contrary the jaggery to the market is

	chemical free Jaggery?	in short supply and needs to be up scaled.
5	What are the hygiene issues in the Jaggery making units existing in the surroundings?	At present the jaggery units of farmers engaged in preparation of jaggery are producing jaggery under most unhygienic conditions. The units have kaccha housing with mud flooring and tiled house with opening from all ends. As a result, insects (ants, cockroach, honey bees and wasps), rodents etc., will invade into the units making the jaggery so prepared unfit for consumption. The juice conveyance is in the open ducts which attracts insects and microbes. Overall ambience is under most unhygienic condition which is prone to easy contamination besides jaggery moulding units that is in the cooling pit the maintenance is unhygienic
6	Is hygiene in the Jaggery Park certainly and surely better than the Jaggery making units existing in the surroundings?	**Yes.** Jaggery park maintenance is highly hygienic. Indeed, the park is having food grade steel crusher, food grade stainless steel tank and food grade stainless steel boiling pans besides, a cooling pit with granite flooring. In addition, only organic clarificants are being used to remove the scum and improve the quality of jaggery.
7	What are the views of Jaggery making unit owners on using chemical clarificants vis a vis herbal clarificants in Jaggery processing?	At present, the jaggery prepared in the farmers jaggery unit is sold through APMC. The demand is for pure white bleached jaggery in APMC. As a result, the farmers prefer to prepare white bleached jaggery which can be done only through the use of chemicals. Use of unripe, over aged and lodged sugarcane for jaggery preparation which necessitates the use of chemicals for easy removal of scum to give a bleached colour to jaggery. That is why farmers prefer to use chemicals in jaggery processing. Some farmers also use herbal clarificants in addition to chemical clarificants.
8	What are the opinion of Jaggery sellers and consumers of Jaggery about using herbal clarificants in Jaggery processing?	Jaggery sellers as well as consumer strongly recommend only for use of herbal clarificants which is good for health point of view.

9	Does chemical free Jaggery have a longer shelf life than usual Jaggery prepared with the usage of chemicals? If yes, how much longer or shorter and why?(perception of Jaggery users may be used to answer this)	**Yes.** Use of chemicals like sodium hydrosulphite (hydros), sodium formaldehyde sulphaxilate (safolite), sodium bicarbonate (baking soda) sodium carbonate (washing soda) by virtue of sodium chemicals makes the jaggery more hygroscopic. Depending on the season and relative humidity in the atmosphere jaggery absorbs moisture which makes it watery as a result of inversion of sucrose. Hence, the shelf life of chemical jaggery (30-45 days) is less than chemical free jaggery (90-100 days).
10	What has been the production, sale and utilization pattern of powdered Jaggery, Liquid Jaggery and Jaggery made into unique shapes and sizes?	Though the products like liquid jaggery, powder jaggery are having high quality with higher sugar content, the cost of production is on the higher side. However, due to its good keeping quality and ease of the usage, products need to be encouraged through proper extension methodologies and government incentives.
11	Which States and districts (outside Karnataka and in Karnataka) are the main purchasers of chemical free Jaggery produced in the Jaggery Park?	The major states procuring chemical free jaggery from jaggery park are Rajasthan, Gujarat, Maharashtra, Kerala, Andra Pradesh, West Bengal and Orissa.
12	Which Sugarcane varieties are better for Jaggery making from the point of view of Jaggery yield and quality as per Jaggery making unit owners of Mandya?	The varieties viz., VCF 0517, Co 86032, Co 8371 and Co 92005 have been found to be suitable for jaggery preparation from the point of view of jaggery yield and quality.
13	Is there a control mechanism (legal and procedural) for checking the usage of harmful chemicals in the making of Jaggery and the hygiene aspect in the process of making Jaggery? If not, what mechanism can be suggested? Please elaborate.	Yes. Food safety and Standards Authority of India (FSSAI) under the Ministry of health Government of India is authorized to make inspection to jaggery units on hygiene aspects and take legal action if units do not comply.
14	Please detail a few tests that can be done at home to check whether the Jaggery one is using is chemical free or not.	1. While preparing coffee or tea, during boiling of milk if chemical jaggery is added to milk, it will spoil the milk whereas in chemical free jaggery this will not happen. 2. If jaggery is of pure bleached white colour, apparently it is chemical jaggery.

		3. If jaggery is tasted, chemical jaggery will give salty taste. 4. Chemical free jaggery will emanate good flavour while chemical jaggery will give off flavour 5. Chemical free jaggery attracts small ant species (ನಚ್ಚಿರ) 6. If jaggery is stored for a month or so, chemical jaggery is likely to be watery. 7. Laboratory test (chromatography) can reveal the actual chemical/s present in jaggery 8. Jaggery if immersed in water, if impurities are there in jaggery it will settle at the bottom or float on the surface. This is a simple test to know the inert matter present in jaggery
15	Has the present Jaggery Park fulfilled its objectives? Is a good case made out for having a few more Jaggery Parks in Karnataka? If no, Why not? If yes, what further inputs need to be provided?	The establishment of jaggery parks in the Southern ZARS, V.C. Farm, Mandya under UAS, Bengaluru and Northern Mudhol & Sankeswar under UAS Dharward. parts of Karnataka are highly relevant to meet the farmers requirement of research related issues of sugarcane cultivation and jaggery processing. These institutes have met their objectives partially when compared to the amount spent on infrastructure and technology development. Both the institutes have failed in outreach activities to farmers for transfer of technology developed at the respective institutes. However, efforts should be made to activate these institutes by strengthening the initiated PPP Model for further up scale is the need of the hour. In addition, based on the facts and figures available, it is felt that there is no need for having another jaggery park in the state instead, the present parks may be strengthened with technical and financial support. in order to make use of huge infrastructure for benefit of farming community