ANALYSIS OF NEPALESE COFFEE INDUSTRY: PRODUCTION AND POST-HARVEST ISSUES

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ABSTRACT

Coffee sub-sector has potential to be an important exportable commodities from Nepal while viewing the production and export figure from last twenty years. Despite such scope the coffee industry at present is threatened by some emerging pest and disease problem. Further this industry is searching for suitable technologies related to organic production and post-harvest management. In this review paper, research and development related issues are critically examined and way forwards have been presented.

INTRODUCTION

Coffee is relatively new crop in Nepal and mostly cultivated by small growers; however it holds enormous market potential. Ministry of Agriculture Development (MoAD, 2014) reported that 229 ton coffee was produced in Nepal from 1911 ha with more than 70% of this exported in the year 2013/14 with involvement of 27000 small farmers (NTCDB, 2014). However, 67 tons coffee was imported in the same year. There is huge international and internal demand of Nepali coffee and also enormous potentiality of area expansion. Currently, coffee is grown in 43 districts of Nepal out of which 23 districts are commercially producing coffee beans (NTCDB, 2014). Nepalese coffee enters into international market as speciality coffee and there are 11 registered processing and marketing facilities operated by co-operatives and independent merchants (KC et.al.2016).

Production and Marketing scenario

In Nepal, specialty coffee is cultivated in steep, marginal and shady land at the altitude range of 800-1600 m. Since the production cost is found to be comparatively less and income per tree ranges from $ 1- 6 per annum (AED, 2014), it is considered an attractive cash crop for small and poor farmers of mid hills. There has been significant increase in specialty coffee export from negligible amount in 1994/95 to Rs. 9,93,04000 in 2014/15 (Fig.1). This may be attributed to the higher benefit cost ratio of coffee production (2.71) as reported by Pandit et al. (2015) and 2-3 times more yield than any cash crops (Dhakal, 2004). Further, a study by Sharma et. al. (2015) revealed that the share of household income of Lalitpur and Glumi district coffee producers is about 55% from their farm activity which implies that the food security will also be adversely affected if proper attention is not provided to manage production and management problems of coffee sub-sector. This could be evident from the constant increase in area under coffee production but decline in productivity over past 10 years (Fig. 1).

Production technologies

Nepalese coffee is considered organic by default and there are a few organic certified production pockets (Tiwari, 2010). Two certifying agencies are involved in the certification process at present (NASA and One Cert). The industry is desperately seeking organic package of production. Though recommendation have been made on dose of organic fertilizer by Horticulture Research Station (HRS), Pokhara, using FYM, poultry litter and mustard oil cake (250 g/tree/year) (HRS, 2014), there are availability of various organic manure in market by a number of source and these need to be tested for their reliability as well as suitability for coffee production. Beside these few attempts, the nutrition management of coffee is largely ignored from both research and commercial perspective.

Coffee is shade loving plant and shade management is an important issue. In HRS, Pokhara coffee is grown under

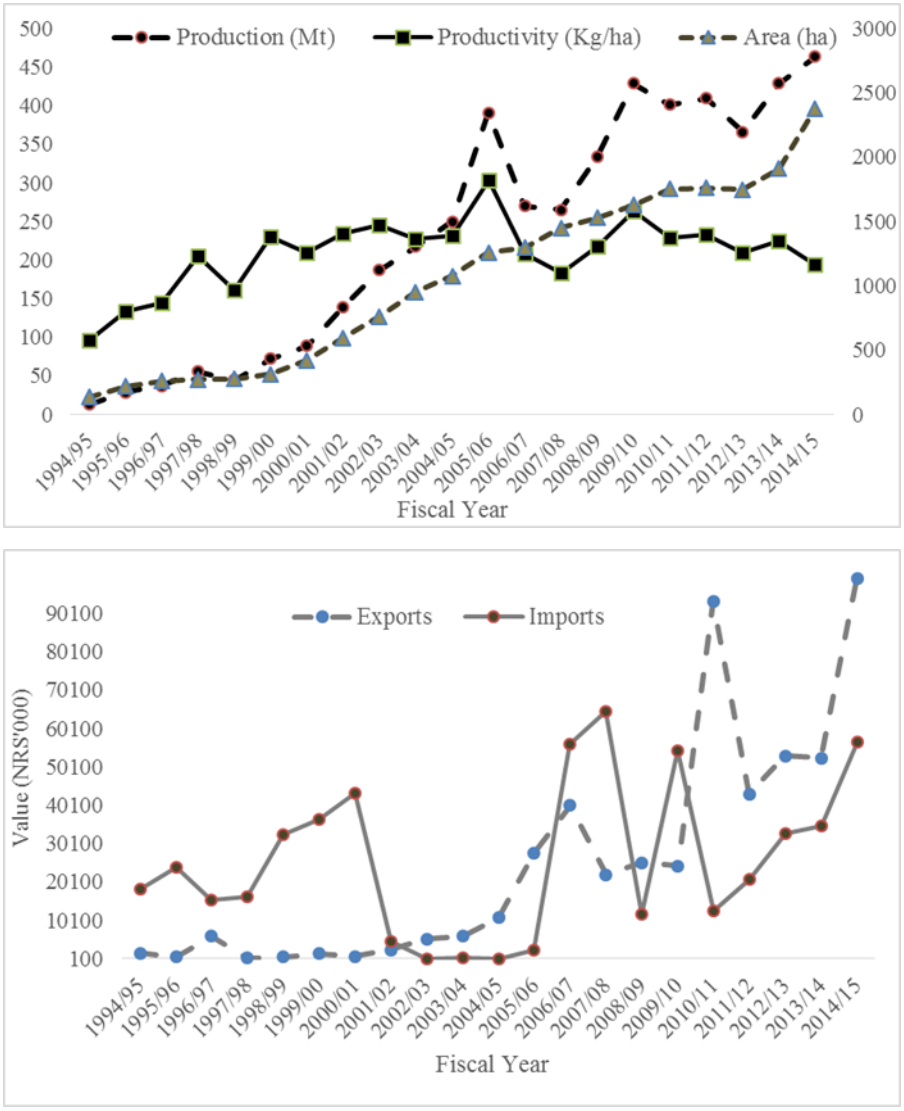

Figure 1: Area and production of coffee (up) and import and export (down) figure in last twenty years. The production figure is on right side of y-axis (Source: NTCDB and MoAD, 2015)

the shade of litchi while in Coffee Research Program, Gulmi the recently established coffee plantation are under temporary shade of pigeon pea (Cajanus cajan; an annual crop). There is program of studying effect of various shade species on coffee production under way by the Coffee Research Program, Gulmi (CRP, 2015).

Government of Nepal has enacted National Coffee Policy (2003) to commercialize coffee farming with special focus on human resource development and mechanization; however, it lacks policy on organic agriculture pocket development and area expansion (Tiwari, 2010). Currently, coffee is cultivated in 43 districts of Nepal with ample production only from 22 districts (NTCDB, 2014). There is scope of increasing area bringing community forest under coffee cultivation. However, the Forest utilization policy is posing hindrance on use of perennial agriculture crops under community forest. Further to improve area and other issues of coffee sub-sector, NTCDB has recently tabled a 'Five year's coffee development Strategy (2016-20)'(goo.gl/tQ60Mv). However, there is prediction of area reduction by 72% due to climate change by 2050 (Ranjitkar et al., 2016). Therefore, care should be taken while expanding are under coffee cultivation as there is recommendation of growing coffee up to the elevation of 1350m as opposed to present recommendation of up to 1100 m. Further, to expand area we need cultivars suitable for diverse ecological zone within country. At present two genotypes of Arabica coffee are grown

in Nepal (Bourbon and Typica). Nepal Agriculture Research Council (NARC) has established two research farms with coffee orchards: National Coffee Research Program, Gulmi and Horticulture Research Station, Pokhara where 23 accessions of Arabica coffee are under evaluation stage. In early evaluation, genotypes 'Tekisia', 'Selection-10', 'Yellow Cattura' and locally collected one 'Arghakhachi local' are performing very well in western mid-hills condition (KC et al. 2016). The promising cultivars will be on farmer's field in near future. However, with increasing threat of new diseases and persistent old insects like white stem borer, care should be given on production of healthy sapling from certified nurseries as well as mother stock with strict quarantine in place while moving sapling from infected area to clean one.

Pest and Disease problems

There are a number of pests and diseases which affect coffee plantation but only two severe and economically important problem have been reviewed in this paper. There is threat of White Stem Borer (WSB), an important pest and Coffee Leaf Rust (CLR) a disease posing hurdle on increasing productivity as well as growth of coffee production area in Nepal.The present projection of loss caused by only coffee leaf rust is about 50% which could reduce the present production by half and so the revenue (PACT, 2014). The compounding effect of loss will be exorbitantly high if the loss from white stem borer and poor processing is added to the coffee subsector. Nepal will lose its international market for organic and fair trade coffee within few years if the present threats of coffee plantation are not mitigated with proper organic management practices. The traditional Coffee producing countries in South America has been largely affected by these two problems resulting termination of Coffee farming (Kubota, 2013). In many countries in that region, farmers have shifted to Cocao farming due to the above issues in coffee which has also been attributed to global warming (Kubota, 2013).

White stem borer

Among 70 genotypes of coffee found worldwide, two genotypes Bourborn and Typica of Arabica genotypes are commercially grown in Nepal (Bajracharyaet.al, 2015) and both are highly susceptible to coffee leaf rust and WSB (SCC, ND; http://goo.gl/UuTVZ9). A study by Entomology Research Division found that coffee white stem borer is number one threat causing yield loss up to 70% (ED, 2007). Further there are three species of this pest attacking coffee namely ;Monochamus leuconotus, Xylotrechus quadripes, and Chlorophorus annulatus. Among them X. quadripes is the most prevalent in Nepalese coffee plantation. A pest surveillance study by Khadge et. al. (2005) and ED (2008) found 10-80% infestation in plantation of Syanja, Gulmi, Palpa and Kavrepalanchowk districts. Despite such economic importance of this pest no scientific research has been carried out so far on management of this perst. However, National Tea and Coffee Development Board (NTCDB) and Coffee Promotion Program, HELVETAS (SDC) have tried sticky trap and sanitation measure to control it but outcome of this action was not documented properly. There are reports of successful use of male sex pheromone against M.leuconotus and X.quadripes but have not been tested in Nepalese context. With banning of chemical pesticides namely, dieldrin and aldrin, considering persistence in environment and affecting non-targeted organisms, the control of WSB is becoming harder even in in-organic production system. A study on development of environmentally friendly, non-toxic, and cheap techniques to control WSB recommended following ways as integrated control measure. The measures are: maintaining optimum shade, tracing infested plants before flight periods each year, collar pruning (infested plants are collar pruned), uprooting (if the borer has entered the root), and burning pruned material, removing loose scaly bark of the main stem and thick primaries using coconut husk but avoiding damage to the stem, spraying /swabbing the main stem and thick primaries during flight period with 10% lime and a wetting agent (Rajbhandari. 2013, http://goo.gl/eWscUo). There is also recommendation of cross -vane trap with NRI (Natural Research Institute) and PCI (Pest Control India) lure to attract female of X. quadripes and kill inside a trap (CABI, 2008; http://goo.gl/pUz6ZB) from a WSB management study in India,

Zimbabwe and Malawi. A study on selection of natural enemies which prey on WSB has been carried out in India (Sitharam, ND; http://goo.gl/RPn8j6) and found few promising insects and chasing this option could be another alternative in managing WSB in organic coffee production of Nepal. The other critical parameter is soil moisture. The Coffee farms needs to have irrigation support so that moisture is available not only for the plant growth but also to keep the soil underneath the plant wet to reduce WSB infestation. Irrigation in conjunction with growing Coffee under shade will largely help to avoid severe WSB infestation.

Coffee Leaf Rust

The Coffee Leaf rust, caused by Hemillia vastratix, outbreak in Nepal is recent development and has affected at least four districts: Lalitpur, Syanja, Kavre and Kaski (http://therisingnepal.org.np/news/8623). There are 45 races of CLR reported affecting Arabica coffee worldwide and only few of them have capability to create devastating situation to coffee plantation of any country (Kubota, 2013). Unfortunately, systematic study on races affecting Nepali coffee plantation is lacking. A study on this is very imperative to track down the disease and develop integrated management approach of CLR in Nepalese context. American Phyto-pathological Society reported that coffee being perennial crop harbours resting structure of pathogen during off-season in few infected leaves (Arneson, 2000). In following year with onset of monsoon the inoculum serves as source of infection and infection occurs with favourable humid and warm climate during and after monsoon. Any measure to reduce the source of inoculum by spraying prophylactic spray of fungicide before onset of rainy season and after rainy season could reduce the spread of this disease. However, Nepalese coffee produced as organic is bound to apply organic measure to control this malady and there is no option for using chemical pesticide. The use of Copper Sulphate is another better alternative when applied early and post-monsoon season, however; care should be given while it is used as it is considered organic measure in one country but in-organic in another country. Further, there is report of new bio pesticide called triadimefon effective in controlling CLR and which need to be tested in Nepali context. Additionally, there are reports on effectiveness of bio control agents ((Bacillus lentimorbus/ B. cereus and Verticilliumlecanii) which need to be isolated from farmers field, further multiplied in the lab and tested on farmers field. Furthermore, there are few varieties (Catimore and Ketistic) which were found rust tolerant at HRS, Malepatan and these need to be distributed to farmers. There are many reports on availability of tolerant varieties in India (Chandragiri, Selection 5A and Selection 6), Brazil and other Central American countries (Batian 1-3, Columbia and Castillo) (CRI, 2016 and Bazak, A, 2014) and introduction and screening of such varieties on disease tolerance to Nepalese CLR races and adaptability into Nepali soil are one of effective measures available at present. However, care should be taken not to import coffee resistant varieties from African countries as it will introduce another malady of coffee, the coffee berry rust. Coffee farming under shade, type of shade trees need to be studied with irrigation support will likely also help in reducing infection of CLR.

Post-harvest technologies

High volume of Nepalese coffee enters into overseas market as green beans and due to involvement of intermediaries Nepalese farmers are not getting handsome price of the produce (Paudyal, 2012). In the contrary, Nepal also import good amount of instant coffee (Fig. 1) as Nepalese prefer instant over filter coffee (Karki and Regmi, 2016). In some instances, there arise issues of non-compliance of Nepalese coffee due to pesticide residue (Koirala and Tamrakar, 2012) or other physical impurities due to lack of technical skill on post-harvest handling and processing knowledge of coffee beans (KC et. al. 2016). The knowledge on good practice of handling cherries to producing final product within the country could boost up the income to small holders and also add value to the coffee subsector. Recently, Food Research Division under Nepal Agricultural Research Council has developed good agriculture practice (GAP) manual for coffee production (FRD, 2015). Nepal Agricultural Research Council still lacks a modest coffee quality testing laboratories and the research work on cup quality assessment of coffee

grown under various agro ecological and production domain is still in an infant stage. The only quality testing laboratory under Department of Food Testing and Quality Control Centre (DFTQC) at Babar Mahal, Kathmandu is heavily loaded with quality checking of various commodities as this is the only government regulatory body to check compliance of various products in the market.

Coffee pulper

Fresh cherry can be processed by two methods: dry and wet processing. In dry processing, whole berries are dried to 10-12% moisture content and the dried skin, pulp and mucilage is hulled, which produces 'fuller' flavor coffee (KC et al.2016). In wet processing, the outer layers (exocarp and mesocarp) are removed by pulping, fermenting and then drying (from 50-55% to 12% moisture content), thus obtained green bean is regarded as higher quality and more valued product due to the most desirable taste characteristics comprising of fine acidity, lighter body and cleaner in cup. However, there is a chance of parchment and beans damage during pulping which may cause serious quality loss as beans are more exposed to the environment and, therefore, prone to deterioration during drying and storage.

To enhance the quality of coffee for international export, wet processing technology was recently introduced in Nepal. Pulping is one of the most important steps of wet processing and hence, more than 350 coffee pulping centres were established. Hence, different types of coffee pulpers viz. wooden roller, metallic roller, metal disc and drum types were introduced in Nepal.

To cater the needs of small scale as well as medium scale pulping, Agriculture Engineering Division (AED), NARC has designed, fabricated and tested different type of pulpers. A team of scientist, engineers & technicians of this division, Genuine Engineering Workshop and General Mechanical Works contributed in fabrication of these prototypes (AED, 2014). Three types of pulpers have been recommende by AED. Among them, Roller Type Hand Operated (RTHP) Coffee Pulper is designed to address the problems of poor bean recovery from wooden and metallic roller pulper for small pulping centers. This pulper is light in weight (25kg with stand) and cost around NRs. 7500.00. After several modifications, the RTHP pulper was comparatively tested with the wooden roller pulper in field condition. The operating capacity of this pulper is 60kg/ hr with pulping and cleaning efficiency above 99 and 96 percent, respectively. Similarly, the broken parchment and parchment loss is less than 0.33 and 0.44 percent respectively. The capacity of the modified roller pulper is found to be increased by 76 percent than the wooden pulper. Similarly, pulping and cleaning efficiency is found to be increased by 2 and 6 percent in modified roller pulper. Further, the broken percentage of parchment and loss of parchment along with pulp is found to be reduced by 62 and 75 percent in this type of pulper.

The second type of pulper, Cycle coffee pulper (CCP), is designed for medium scale pulping centers without electricity facility. It consists of double roller connected by a coupling and is operated using pedal power. The pulper is ergonomically designed so that it is easy to operate and the seat is adjustable as per operator's body size & preference. The capacity of the CCP is 100-120 kg per hour. The weight of the pulper is 50 kg per unit. This pulper is equipped with high precision roller resulting better performance in terms of cleaning and pulping efficiency. Compared with hand operated roller pulper, it requires 50 % less manpower for its operation. It is not yet manufactured in commercial scale.

The third deign is electrically operated pulper, which is similar to that of hand operated roller pulper but it is with robust frame fitted with an electric motor. The capacity of the electrically operated roller pulper is at the range of 120-150 kg/ hr. The pulping and cleaning efficiency is similar to that of hand operated roller pulper. The weight of pulper with stand but without electric motor is 28 kg and its cost is NRs. 9000 per unit.

Coffee dryer

The harvesting time of coffee in Nepal coincides with winter season with less intense sun rays to dry coffee bean naturally The tunnel type solar dryer is fabricated and tested to solve such issues. The capacity of such dryer of size 5 x 2.4 m is to dry 180 kg green stuff per cycle. It was tested for drying various horticultural products, where 2-3 days are sufficient for complete drying. This dryer need to be tested drying coffee bean. AED has also developed large scale solar tunnel dryer and its performance was tested for different agro products such as mushroom, squash, cumin, radish and potato at Khumaltar, Lalitpur condition. Further, it has been modified to lower the cost of manufacturing and named as Low-Cost-Solar-Tunnel (LCST) dryer using locally available materials in rural farmers such as Bamboo, wood, stone etc. and disseminated in various parts of mid-western hills and high hills to dry different horticultural commodities. The LCST dryer also shows promising result for drying coffee seed from experience of AED researcher and need to be verified on field condition.

CONCLUSION

Government research body (NARC) should focus on development of package of practice for organic coffee production (for e.g. testing of shade trees for different growing areas and organic fertilizers and pesticides) and strengthening its laboratory facilities for quality analysis of various constituents of coffee. Further, introduction and evaluation of CLR and WSB resistant coffee cultivars from abroad should be initiated immediately to deal with these two devastating diseases. While introducing new coffee cultivars, care should be taken not to introduce cultivars from African countries as germplasms from these countries are prone to coffee berry rust and Nepal is till now free from this disease. Coffee promotion body of GoN such as NTCDB and DADOs should focus on production and promotion of healthy coffee saplings using certified pest free nurseries (for e.g. subsidy for coffee plants should be only given where there is shade in proposed plantation area) Additionally, these nurseries should be only allowed to produce plants of designated varieties recommended to specific areas. Further government authorities should focus on quarantine regulation in place while transporting saplings from CLR and WSB infected to clean areas. Irrigation programs needs to be launched for good and healthy growth of organic coffee production pockets by concerned bodies. Private sector has to be stimulated to develop instant coffee processing facilities within country to reduce the volume of coffee import and increase export quantities. Another alternative to this could be training and establishment of small scale processing facilities near the production site which adds value to local coffee sector.

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