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Rhamnus prinoides in North West Ethiopia: Production, Contribution and Constraints

Takele Ferede, Dagninet Amare*, Biazen Endalamaw and Tigsit Genanew

Adet Agricultural Research Center (ARARI), Ethiopia

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***Corresponding author:** Dagninet Amare, Adet Agricultural Research Center (ARARI), Adet (West Gojjam), Ethiopia, Email: dagnnet@gmail.com

Abstract

Rhamnus prinoides is a widespread plant species well distributed in Ethiopia in different agro-climatic zones. Locally it is used for cash income, local beverage preparation and medicinal values. The contribution of the crop has grown steadfastly due to the demand in local markets and the promotion of the plant as one of the biophysical methods to maintain soil and water conservation structures. Besides, its economic value, the production and constraints of *Rhamnus prinoides* is not documented formally and scientifically in Ethiopia at all. This study was therefore conducted to assess the production and constraints of *Rhamnus prinoides* in one of the major production areas of the country. Data was collected from formal household survey and field observation and analyzed by descriptive statistics and linear regression model. The result revealed that the households of the region have on average 145seedlings/plants of *Rhamnus prinoides* mainly around the homestead. Cutting the stem from the bottom of the tree, cutting the new branch by sickle, rolling the shoots and leaves by hand and picking only the leaf by hand are the harvesting techniques practiced by the households. The farmers harvest on a rate of 2.48 per annum with average marketable leaf yield of 13.8kg per tree per harvest. The presence of provenance was reported based on the morphology of leaf, stem and fruits. Diseases management, support in initial investment and investigation of the provenances of *Rhamnus prinoides* are crucial to increase the benefits for smallholder.

Keywords: Benefits; Harvesting technique; Opportunities; Provenance; *Rhamnus prinoides*

Opinion

Rhamnus prinoides, Gesho in Amharic, is a widespread plant species in African countries. It is a native plant to Ethiopia and other countries in East and South Africa. The plant grows best in areas where the mean annual temperature falls within the range of 14-22 °C, and can tolerate 8-32 °C. It prefers a mean annual rainfall in the range 600-800mm, tolerating 500-1,200mm and is usually found in areas with a distinct dry season. Generally, slow-growing when in low rainfall areas, though it can grow 1 meter per year in wetter areas.

Rhamnus prinoides (RP) is widespread in Ethiopia from medium to high altitudes on the margins of every green forests in moist & wet Kolla, woina Dega and moist Dega agro climatic zones [1,2]. CSA (2015/16) indicated RP in Amhara Region is produced by 1462206 holders on an area of 20664 ha with annual yield of 21761.3tons. The production of RP and its economic contribution was documented by Amare et al. [2] and Tefera et al. [3]. Farmers' preference ranking indicated that RP was the second most preferred tree species among farmers in northern Ethiopia Tefera et al. [3].

RP is used for a variety of purposes, including flavoring of beer, as medicine, treat respiratory systems (Bekele, 2007; Gebre, 2012; Amare et al. [2]. In Ethiopia, it is commonly used for preparation of traditional alcoholic beverages, "tella" and "tej" [4]. The concentrations of the metals were also compared with recommended maximum permissible limits and some international reports; and found to be in a good agreement indicating no exposure risk of using the leaves and stems of RP under the current situation [1]. Berhanu [5] concluded that total resin, soft resin, hard resin and essential oil of RP were found to be comparable with values of varieties of hops indicating RP as a substitute for hops in beer production.

The demand for RP has been increasing due to a growing demand for local beverages. Concurrently, the production of RP has been rising as it is incorporated as a biological measure in the effort of natural resources management activities widely implemented in the country. Even if there are sporadic reports Amare et al. [1]; Tefera et al. [3]; Amabye [6], there is no such cross sectional data generated in Ethiopia. Hence, this study aimed at a) exploring the production of RP, b) assess the provenances of RP, and c) investigate the production and marketing constraints in the production of RP under smallholder farmers.

Study Area

This study was conducted in Amhara regional state, Ethiopia. The areas covered south west part of Amhara Region on four administration zones; viz West Gojjam, East Gojjam, South Gondar and Awi zones. Farta, Estie, Dera from south Gonder; Basoliben, Huletejienebsie, G/s/enebsie from East Gojjam; Quarit, Mecha, GonjiKolela; and Fagita Lekoma and Guagsa from Awi zones. The altitudes range from1938 to 2564masl (Figure 1).

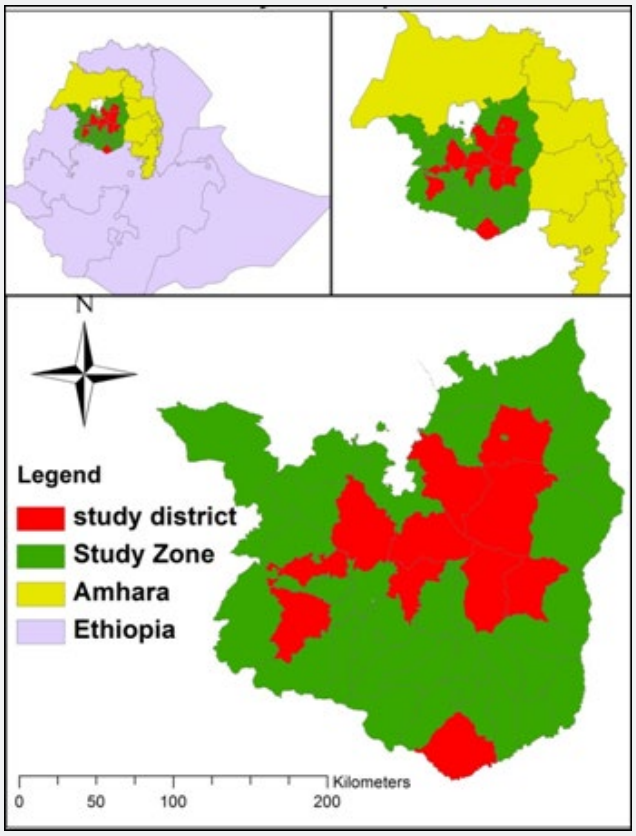

Figure 1: Study area.

Research Method

Multi stage sampling procedure was used to select RP producing kebeles. Purposive sampling method was employed to select respondent farmers. Sample size was determined based on information saturation technique. The potential districts were selected within each zone based on the secondary data of zone agricultural office annual seedling distribution and tree coverage reports. Similarly highly potential kebeles were selected from each woreda's report and 10 farmers were selected from each kebele purposively, which have knowledge about RP use and management.

Household survey data were collected using structured and semi structured questionnaire. The household questionnaire consisted questions on demographic and socio-economic conditions, the livelihood strategies and RP plantation activities. The questionnaire was also pretested prior to the actual survey and correction has been made based on the information received. The questionnaire was translated into the local Amharic and Age wugna language and for respondents who only speak Age wigna; Development Agents were used as interpreters while conducting the interview. In addition to the informant interviews, information were collected from kebele office, field observation and informal discussions. Among the respondents, 18.18% are from Awi Zone while 27.27% from each administration zone of West Gojjam, East Gojjam and South Gondar, respectively. The female respondents represent 14.5% of the total sample population while the rest, 85.5%, are male respondents. The survey data were analyzed using descriptive statistics and a linear regression model. SPSS 16 and Stata 12 software packages were used for analysis.

Results and Discussion

Household characteristics

The average family size of the respondents was 6.3 with minimum 2 and maximum 12 numbers of family members. The average age of the respondents was 47. 47 year with a range of 24 up to 80 years. Almost half (44.5%) of the respondents were illiterate and the rest attended formal education (i.e., primary, secondary and preparatory schools).

Intensity of RP Production

The numbers of RP plant per farmer was a minimum of 6 in Gawana (Awi) and maximum of 5000 in Enegodie (East Gojjam). A household cultivated on average 508 RP plants. Most of the farmers have 50 to 200 number of RP plant but only 11% of them have above 1000 plants. The income contribution of RP ranges from 150 birr up to 20,000 ETB annually with average income of ETB 3822.43(±389.39). RP is also used for home consumption in varying volumes.

Sizeable proportions of the farmers (47.71%) involve in commercial RP seedling production and earn averagely ETB 7356(±106) by producing bare root (76.36%), potted (3.64), and both bare root and potted (20%) seedlings.

Planting Trends of RP

Table 1: planting number of trees per year.

Zone	Minimum	Maximum	Average
W. Gojjam	10	200	58
E. Gojjam	10	300	95
Awi	5	60	24
S. Gonder	5	110	46

The farmers planted RP for the last five years (Table 1). The average annual planted RP seedlings were maximum in East Gojjam (Enegodie) and minimum in Awi (Gawana) and South Gondar (Gindatemem). On average the survival rate of planted RP seedlings was 72% indicating a better management or environmental condition for RP seedlings.

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Management Activities

RP is produced at different land uses (Table 2). According to farmers, the management of RP requires additional effort compared to other traditionally known agro forestry tree production (e.g., eucalyptus). From the total respondents, 89.1% agreed that RP production requires additional effort or management activities such as, hoeing, weeding, watering, mulching with straw and fencing than other Agro-forestry trees. Due to this, most of the farmers grow RP near to the homes while 70.9% of the respondents indicated that humus soil is more preferable for RP cultivation. Water logged soils have negative effect on the productivity of RP, according to the farmers.

Table2: Farmers planted RPin different plots and land use.

Types of Land Use	No of Respondents	Respondents (%)
Around homestead	100	91
On croplands	23	20.9
On irrigated lands	2	1.8
On soil and water conservation structures	19	17.3

Harvesting Frequency and Harvesting Techniques

Harvesting frequency is the harvesting time of one plant per year. Accordingly, 44.55% of the farmers harvest twice per year. Others, 30.91%, 12.73%, 8.18%, 0.91% and 2.73% of the respondents harvest 3, 4, 5 and 6 times a year respectively. Harvesting frequency depends on harvesting technique, tree management practice and the site of plantation. Picking only the leave by hand harvesting techniques have better harvesting frequency than the other techniques. Average yield per tree per harvest was 13.6 kg.

Harvesting Technique

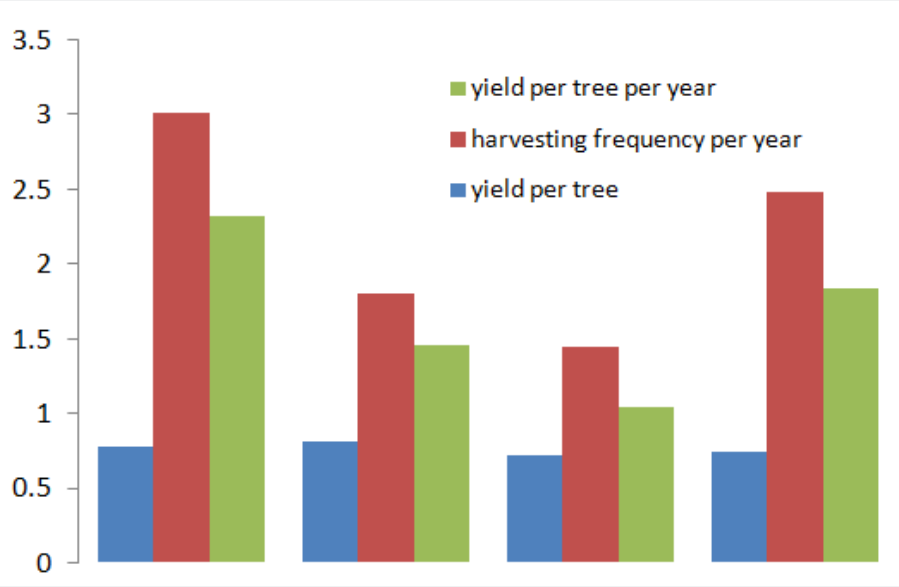

Figure 2: Yields in different harvesting technique.

There are four different types of harvesting techniques (Figure 2); namely, (a) cutting the stem from the bottom of the tree (e.g., in Yelemelem); (b) cutting the new branch by sickle (e.g., in Quarit and Engode); (c) rolling the shoots and leave by hand (e.g., in Gawana, chiguale); and (d) picking only the leave by hand (e.g., Biraqat, Gonji, and south Gondar).In general, there was no a single harvesting technique practiced by the farmers.

The yield of RP depended on the harvesting technique employed (Table 3). Picking only the leaf by hand gave better yield per year per tree. This was due to the increase in harvesting frequency while yields per harvest per tree were almost similar across different harvesting techniques. Provenance

Table 3: Yield in different harvesting frequency.

Harvesting Frequency	Yield Per Plant in Quintal (18 Kg)	
	Average Yield Per Harvest	Std Error
1	0.82	0.08
2	0.83	0.04
3	0.67	0.06
4	0.64	0.06
5	0.75	-
6	0.86	0.34

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Most of the respondents (72.7%) agreed on the presence of provenance and characterized the difference by plant morphology such as; leaf size, stem length and thickness, fruiting potential and growth rate. The farmers expressed the number of RP varieties they ever know and are producing as single variety (27.27%), two varieties (59%) and three varieties (13.64%). Based on the focus group discussions and field observation, two types of provenance were identified in the study areas. They are; (1)long in stem length, wider leaf size & have more leaves, fast growth and non or less fruited and, (2) dwarf, smaller in leaf size, more fruited and give less yield.

The farmers (73.79%) indicated that there is a difference in variety. The broad leaved RP is indicated as more productive (91.35%) than the small leaved RP species. Leaf thickness is one of the preference criteria reflected in the market as reported by farmers (56.88%). The farmers described that broad leaved (60.87%) and small leaved (18.84%) are generally preferred by the market, respectively.

Opportunity

There are different opportunities for the production of RPin the study areas (Table 4). In addition to home consumption (using "Tella", "Teji" and "Katikala" preparation), RP is one major source of income, which means market demand is the first opportunity to push farmers for production. Market demand, land suitability and water availability are major opportunities for the production of RP and its benefits for smallholder farmers (Figure 3).

Figure 3: RP leaf market in different areas.

Table 4: Opportunities of cultivation and production RP.

Opportunity	Frequency	Percentage
Market demand	63	57.2
Land suitability and availability	42	29.2
Water accesses	24	21.8
Labor availability	18	16.4
Seedling accesses	2	1.8
SWCS constriction	3	2.7

Constraints

Insect and disease (as described by 92.7% of the respondents) are major problems indicated by farmers that limit production and benefit from RP production. Seasonal market problem, limited extension support and request of additional labor or effort for the management of the plant (weeding, watering, mulching, hoeing and fencing) are other constraints put forward by farmers (Figure 4).

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Figure 4: RP leaf damaged by insects.

Factors Affecting Income from RP Leaf

Income from production of RP constitutes 18.33% of the total annual income (ETB 20850) of the households while the income from other agro forestry practices is in the ratio of 0.916. Age of the household head, extension support for RP production and total income of the household head were significantly and positively correlated to income from RP production. Age was positively correlated due to the management and more dependency of older households. Older households acquired vast knowledge and skill on better management of RP and hence gain better benefits or income from RP production. Further due to labor shortage, older households lean more on permanent crops like RP including other agro forestry products. Hence, the positive correlation of age and income from RP is perfectly explained by the knowledge and skill possessed as well as the limited labor availability in older households that forces them to shift away from crop production and engage in permanent crops like RP production (Table 5).

Table 5: Determinants of RP income.

Variable	Coef.	Std. Err.	t
Total income	0.18	0.031	5.85***
Age	45.616	27.846	1.64**
Sex	412.688	1082.872	0.38
Formal education	828.098	750.26	1.1
Extension support	2832.221	699.077	4.05***
Total land size owned	-37.031	689.142	-0.05
Constant	-3975.183	1749.343	-2.27*
No.=104; F(6, 97) =9.99; prob>F=0.000; R-squared=38.19; Adjusted R-squared=34.36;Root MSE=3301.8			

Further, extension support was positively correlated to income from RP. This is due to farm households that gained better knowledge and skill on the management, will manage their RP trees and hence better benefit compared to other households that manage traditionally. Also, extension support could have delivered farm households better information on market information, use of the tree for natural resources management activities, and hence the farmers could have planted more RP seedlings compared to those households that did not get extension support.

Conclusion and Implications

Our results indicated that the farmers in western Amhara for income generation and as soil and water conservation tool. The cultivation is mainly situated around homesteads due to managerial and soil fertility requirements.

Different types of RP provenance are reported and identified. Further, in detail study on the exact number and types of provenances. Also investigation of the chemical composition of the RPs will be useful to integrate the production system to the ever expanding beer market that consumes huge volume of hop

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as the local RP may likely replace the import of hop from abroad. Besides, exploring the benefits and tradeoffs of the four different type of harvesting techniques is crucial.

The positive correlation of total income of the households with income from RP indicates that RP production as manifested by the management activities is investment intensive activity. Hence, provision of financial or seedling backing by the government or other stakeholders may be desirable, especially for the needy and households with short in labor (e.g., women headed households, older families).

Insect and disease influence the production RP. Management activities targeted towards diseases and pest management should be delivered by the stakeholders. Although tree planting is increasing, there is a need to work on market linkage, harvesting technique and frequency determination and provenance selection.

Acknowledgement

We thank all experts at Zone, Woreda and Kebele level that helped in selection of respondent farmers and delivery of secondary information. We are indebted to our farmers that were patient and willing enough to offer their knowledge in RP production-marketing-consumption.

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