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FULL LENGTH ARTICLE

# The effect of agricultural extension services: Date farmers' case in Balochistan, Pakistan

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Agri-extension;
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**Abstract** The Government of Pakistan has adopted a policy of providing agricultural extension services to promote agricultural production by disseminating appropriate knowledge and technologies to farmers. Consistent with this national policy, farmers in Balochistan have been provided with extension services by the provincial Department of Agriculture through their extension officials working with the District of Agricultural Extension Department. The required information was collected from a questionnaire survey covering 200 date palm farm households, group discussions, and surveys of key informants in the Panjgur District of Balochistan. Contrary to the policy of providing extension following the participatory approach, the extension in the study area was provided through the age-old top-down approach, with particular field-level extension officials not having much knowledge with regard to addressing date palm specific production problems. Of the farmers who had access to extension services, only half of them had made use of the knowledge/technology provided by extension officials. Overall, the small-scale farmers who used the extension services produced a better yield compared to that of the medium- and large-scale farmers. The linear regression model highlighted five factors that significantly influenced production. Those variables included the total number of date palm trees, the land preparation method recommended by extension officials, frequency of irrigation, expenditure on pesticides as recommended by extension officials, and farm-household income. Overall, farmers in the study area were found to have very poor access to extension services due to a combined effect of several factors. This was partly attributed to institutional constraints, including a very limited number of extension workers and their lack of knowledge on how to address date palm specific problems, such as the Dubas bug, which had infested approximately 90% of trees, and the shortage of irrigation water for around 90% of farmers, which caused a 65% decrease in date production. Conclusions are drawn based

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on the findings of the analysis, and resulting recommendations have been made for improving the extension services.



## 1. Introduction

The provision of agricultural extension is made to enhance farmers' knowledge and skills toward improved yield. This section aims to find out the effects of available extension on date-palm yield in the study area. Therefore, the concern is whether the extension could achieve this explicit objective. However, the studies on factors influencing any crop yield indicated that besides extension, several other factors influence crop yield. Similarly, the infrequent use of advanced technologies and extension services is not only the farmers' unwillingness or objection to those services, but due to erratic and poor service delivery, insufficient number of extension officers and workers, and a lack of equipment. Poor transportation facilities and infrastructure (e.g. road system and office buildings), and poverty are understood to further aggravate the dissatisfaction of farmers with agricultural extension services (Qamar, 2005; World Bank, 2010; Ghosh, 2012). Even though extension services are offered to farmers, regardless of the size of their farm land, they thought them to be inadequate, because of not meeting their specific needs. Inadequacy of the provided services accounted for the reluctance of farmers to seek extension services (Umeta et al., 2011; Siddiqui and Mirani, 2012; Benjamin, 2013). Studies indicated that date palm farmers seemed to have been failed to effectively mitigate the date palm associated problems such as pest, mice bites and diseases and traditional farming (Siddique, 2006; PHDEB, 2008; Shah et al., 2010; El-Juhany, 2011; Al-Sharafat et al., 2012). According to Al-Sharafat et al. (2012), it is articulated that there was no difference in between olive farmers' production and income who received public extension services and other who did not avail services. Similarly, El-Juhany (2011), argued that due to pest, diseases and indeed the ineffective extension services provided to farmers the productivity of date palm trees has declined in Balochistan, Pakistan, by 37% (GoB, 2005; PHDEB, 2008) and 30% within a decade in Arab countries namely Iraq, Saudi Arabia, United Arab Emirates, Egypt, Tunisia, Algeria and Morocco. It happened mainly due to ineffective extension services i.e., untrained extension officials, lack of field demonstration, and neglecting the farmers' actual problems and the traditional farming (Qamar, 2005; World Bank, 2010; El-Juhany, 2011; Ghosh, 2012; Baloch and Thapa, 2014) (see Table 1).

Based on primary (in particular) and secondary sources, the study is an attempt to understand the effects of agricultural extension services provided by institutions in the study area with regard to the key "needs and problems" faced by the date farmers improving their date production and income. In the same manner, the key challenges, problems and "loopholes" identified by date farmers (smallholders in particular), extension workers and the policymakers would be significantly addressed in this study. More significantly, this study has eventually come up with constructive research-based findings, and empirical policy instruments that can reflect the achievements in addressing the "effects of the extension services" with regard to the actual requirements and problems faced by the smallholder/resource-poor date farmers. As a result, it can contribute and enhance the knowledge of policymakers, development planners, practitioners, academics, general readers and other stakeholders.

## 2. Study area and methods of data collection

We selected the Panjgur District as our study site because it is among the leading date producing districts in Balochistan (PHDEB, 2008; GoB, 2008). Covering an area of 16,891 $km^2$, with elevations ranging from 465 to 1776 m above the mean sea level (GoB, 2011), the district features dry climatic conditions, which are suitable for date cultivation. Although agricultural land accounts for only 4.6% of the district's land area, the economic mainstay for the majority of the population is livestock production and land cultivation, of which date palm is the major crop (Ghicki, 2011; GoB, 2011).

Historically, date palm was already grown in the area when Alexander the Great traveled through the Ketch Valley of Balochistan in the 4th century BC (IHS, 2011). Date palm is known as one of the most resilient species of trees and can survive for several months with very little water as well as in severe climatic conditions (Saleem et al., 2005; Baloch et al., 2006). This hardiness combined with the market demand for dates might be the main reason why the ancestors of the present-day farmers first started cultivating date palm in Balochistan. The climate of the area is also suitable for growing date palm. Starting in May and continuing for only 5 months until September, the Balochistan summer is relatively shorter than the winter, which starts in October and lasts for 7 months until April. June and July are the hottest months; November, December and January are the coldest. The average temperature in summer is usually below 32 °C, although the hottest months can sometimes peak at 38 °C. In the coldest months, the mean temperature drops below freezing point (GoB, 2005, 2011).

Panjgur district comprises 16 union councils, which are the lowest administrative units of Pakistan. From the union councils, Gramkan was randomly selected for the survey. Gramkan is home to almost 300 households (District Agriculture Extension Department) which grow date palm as their main source of income to meet their basic needs including food. Therefore, this union council was selected for the survey. Following a reconnaissance conducted in March 2012, 200 date palm farm households, accounting for two-thirds of all date palm farmers in the union council, were surveyed. As no secondary information existed on individual date palm farmers, the farm households to be surveyed were selected by using the random sampling method. Accordingly, two university-educated field assistants were chosen to go into the villages at certain intervals and select farm households to participate in the questionnaire survey. Prior to conducting the survey, the assistants

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**Table 1** Strengths and weaknesses of the top-town and participatory/decentralized extension approaches. *Source:* Roling (1990), Hagmann et al. (1999), Rogers (2003), World Bank (2010).

| Top down operational system | Participatory approach |
|---|---|
| *Strengths* | *Strengths* |
| It involves top-level decision makers (government bureaucrats, policy makers, I/NGOs heads and project planners and managers) | It is a 'decentralized system', which ensures involvement of the key stakeholders (policy makers, project managers, extension workers, subject specialists, researchers, and farmers, particularly, the smallholder farmers) problem-solving and implementation process |
| Project planners and subject matter specialist (SMS) identify and address key problems at top level (green revolution is the best example where small farmers' concerns and problems were documented) | Farmers facilitated by outsiders where extension worker encourages farmers to share knowledge and experiences (called 'diffusion of innovation')<br>Farmers are involved in the problem-solving process (Problem-identification, decision-making, implementation, monitoring and evaluation) |
| *Weaknesses* | *Weaknesses* |
| It is a 'centralized system' of implementing extension services ("small holder farmers view points and concerns are neglected and not taken into account") | So-called participation, untrained farmers, meager operational budget accompanied by inadequate transportation facility particularly in developing countries. In addition, the effects of the participatory agricultural interventions and extension services vary (un/successful) even within the country, state and district level. If there is any change seen it is at small-scale |
| Outsiders are hired with specific instructions and tasks without thinking of smallholder farmers' concerns, limitations/strengths and participation. Extension workers play a teacher and trainer role in disseminating knowledge and information | So-called trained farmers, mostly large holder farmer or a few extension workers and smallholders are trained and pretended to share information, knowledge to other fellow farmers which called "diffusion of innovation" |
| Many developing countries such as Nigeria, Korea, Thailand, Cambodia, Myanmar, India and Pakistan in particular, their respective governments and I/NGOs apply top-down approach which is one of the major failures of the system, resulted in continued decline in production, yield and returns accompanied by significant increase in poverty in farm-based households | Most of farmers are with insufficient resources (i.e., capital, farm implements, fertilizer and pesticides, water, quality seed, breeds, modern technology) |
| Mostly rich farmers avail the services | Smallholder farmers do not equally gain benefits from services |
| Developing crop management skills, transfer of technology | Empowering smallholder famers |
| The 'menu' of extension services is fixed | Extension services are planned according to choice and need of farmers ("basket of choices") |
| Farmers behavior is assumed to hear message; act on percepts; adopt, adapt or reject packet | Use methods; apply principles; choose from basket and experiments |
| Poor documentation (recording, monitoring and evaluation) of failures and challenges faced by the majority of farmers (i.e., smallholder farmers) especially in developing countries | Extension workers keep records using "Diary" and document the change (i.e., knowledge and experiences gained, in both the success and failure scenario), and eventually, address them to the policy makers and project managers for actions |

were trained and prepared by the first author. As the majority of farmers are not able to read and write even in the local language, the assistants as well as the first author read every question in *Balochi*, the language commonly spoken in the study area. Even the literate farmers requested that the questions be read to them as they found it easier to respond in this way. The questionnaire was pretested and revised as needed before the main survey was conducted. Additional information was also collected from date farmers and 33 additional key informants, consisting of the Agriculture Minister; the Director General of Agriculture Extension, Balochistan; the Deputy Director of Agriculture Extension, Panjgur District; 8 agriculture officers; 10 extension workers; and 12 community leaders. These key informants provided information on various aspects of agricultural extension, including the access to, usefulness of and application of those services as well as the actual problems faced by the date palm farmers due to poor extension services and lack of organizational support.

The traditional land tenure is very a complex system in the study area. Surprisingly, out of the 200 farm households we sampled, no farmer knew the size of their landholding. The key informants and agricultural extension officials informed us that a similar situation exists across the entire district. Therefore, this is a great concern for the District Agricultural Department. However, it was confirmed that most date palm farms are inherited and owned by extended family members, with the specific trees owned by individual households. The farmers know very well which date palm tree belongs to whom. Therefore, the grouping of farm households based on landholding size has not been considered sensible for the purpose of analysis. As an alternative, farmers were categorized based on the numerical ownership of date palm trees. Farmers with $\leqslant$100 trees are categorized as small-scale farmers, those with 101–200 trees as medium-scale farmers, and those with $>$200 trees as large-scale farmers. Of the total 200 farm households we sampled, 111 belonged to the first group, 49 to the second group, and 40 to the third group.

Initially, researchers used ANOVA which portrayed the general scenario of farmer groups and the yield produced per date palm tree. The in-depth results of (linear regression)

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analysis are explained below. Accordingly, this section analyzes the role of extension together with other factors related to farmers' socioeconomic characteristics using the multiple regression method. As the dependent variable "date-palm yield" is parametric, this method is considered most suitable for such analysis (Field, 2009).

The findings showed that though less than half (out of 157 farming households) of date palm farmers used the extension services, they produced better yield in the study area. Overall, the small-scale date palm farmers who used the extension services on land preparation and pest control acquired from the public extension officials produced better yield compared to medium and large scale farmers (Tables 2 and 3). Similarly, medium-scale farmers were found to be producing better yield compared to large-scale farmers. However, the initial analysis revealed with the general findings; therefore, researcher further applied the multiple regression to understand the factors that significantly influenced the yield of the date palm.

## 3. The effect of agricultural extension services on date palm yield

This part analyzes the impact of extension services on date palm yield. As the yield of any crop is determined by several factors, this study has adopted a holistic approach while performing analysis.

### 3.1. Date palm production

Overall, the annual average production of date palm rose by increasing the number of date palm trees as reflected in the large-scale farmers producing the highest amount and small-scale farmers producing the lowest amount (Table 2). However, when the yield was considered, the reverse was true; small-scale farmers, mainly dependent on the agriculture sector, could better manage fewer date palm trees in the study area. As a result, the small-scale farmers had the highest date palm yield, followed by medium- and large-scale farmers, indicating that the small-scale farmers were more efficient than other farmers. This is consistent with Schultz's (1964) assertion that small-scale farmers are "poor-but-efficient", which is corroborated by the findings of several empirical studies (Wiggins et al., 2010; World Bank, 2010). Consistent with the hypothesis, the empirical studies have proven that although small-scale farmers in developing countries are "poor", they are "efficient" as they are able to effectively utilize the resources available to them, including labor force, man-hours, irrigation water, appropriate seeds/breeds, fertilizer and pesticides (Rogers, 2003; Sachs, 2006; World Bank, 2010; Wiggins et al., 2010, 2013; Ghosh, 2012).

The findings show that although fewer than half (out of 157 farming households) of date palm farmers used extension services (Table 4), they produced a better yield in the study area. Overall, the small-scale farmers who used the extension services on land preparation and pest control (acquired from public extension officials) produced a better yield compared to that of medium- and large-scale farmers (Table 3). Similarly, medium-scale farmers produced a better yield compared to large-scale farmers.

**Table 3** Effects of extension services on date palm yield. *Source:* Field survey (2012).

| Farmer groups | Average yield | Std. deviation | *F*-test (Sig.) |
|---|---|---|---|
| *A1. Land preparation: farmers who received extension services (n = 88)* | | | |
| Small-scale farmers | 17.4376 | 13.72273 | .004 |
| Medium-scale farmers | 9.8849 | 5.60984 | |
| Large-scale farmers | 9.8079 | 5.54451 | |
| Total | 13.4756 | 10.91026 | |
| *A2. Land preparation: farmers who did not receive extension services (n = 112)* | | | |
| Small-scale farmers | 15.6140 | 8.78144 | .002 |
| Medium-scale farmers | 12.8247 | 15.48494 | |
| Large-scale farmers | 7.3065 | 4.33265 | |
| Total | 13.3606 | 10.05707 | |
| *B1. Pest control: farmers who received extension services (n = 69)* | | | |
| Small-scale farmers | 18.5201 | 15.17768 | .010 |
| Medium-scale farmers | 10.2161 | 5.98132 | |
| Large-scale farmers | 9.4964 | 5.91975 | |
| Total | 13.9525 | 11.90346 | |
| *B2. Pest control: farmers who did not receive extension services (n = 131)* | | | |
| Small-scale farmers | 15.4063 | 8.54053 | .001 |
| Medium-scale farmers | 11.9390 | 14.13995 | |
| Large-scale farmers | 7.8559 | 4.55540 | |
| Total | 13.1261 | 9.57469 | |

#### 3.1.1. Factors influencing date palm yield

As mentioned above, the yield of any crop is dependent on several factors. Therefore, this section analyzes crop yield by taking into account several socioeconomic and institutional factors, including agricultural extension related to land preparation, irrigation and pesticide application.

#### 3.1.2. Model specification

As the dependent variable "date palm yield" is quantitative, factors influencing it were analyzed using a linear regression model. The regression model was employed to identify the variables that significantly explained the variation in the yield. The model is specified as follows:

**Table 2** Date palm production by farmer type. *Source:* Field survey (2012).

| Farmer groups | *n* | Mean gross production | *F*-test (Sig.) | Std. deviation | Mean yield kg/tree | *F*-test (Sig.) | Std. deviation |
|---|---|---|---|---|---|---|---|
| Small-scale farmers | 111 | 878.5586 | 47.688 .000 | 476.16431 | 16.3040 | 11.463 .000 | 10.89262 |
| Medium-scale farmers | 49 | 1468.5714 | | 1360.22057 | 11.0248 | | 10.53691 |
| Large-scale farmers | 40 | 3148.0000 | | 2259.22519 | 8.3071 | | 4.94312 |
| Total | 200 | 1477.0000 | | 1527.39769 | 13.4112 | | 10.41444 |

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**Table 4** Regression coefficients of variables influencing the date palm yield. *Source:* Field survey (2012).

| Indicators | Description | Unstandardized coefficients | | Standardized coefficients | *t* | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. error | Beta | | |
| (Constant) | | 3.226 | 5.181 | | .623 | .542 |
| $X_1$. Date palm trees (HH) | Total number of trees | −.050 | .009 | −.925 | −5.290 | .000 |
| $X_2$. Land preparation | 1 if used public extension services; 0 otherwise | 17.731 | 4.595 | .641 | 3.859 | .001 |
| $X_3$. Frequency of irrigation | 1 if irrigated once a week; 0 if otherwise | 10.952 | 4.559 | .348 | 2.403 | .028 |
| $X_4$. Spending on pesticides as per extension officials' advice | Annual expenses | .001 | .000 | .432 | 2.548 | .021 |
| $X_5$. Farm income (HH) | Annual income | 0.0000442 | .000 | .412 | 2.640 | .017 |
| R-square | 57.9% | | | | | |

$$Y = b_0 + b_1X_1 + b_2X_2 + \cdots + b_nX_n + u_i$$

$Y$ = Yield (kg/tree),
$b_0$ = Constant,
$b_1$–$b_n$ = Coefficient of the independent variables,
$u_i$ = random term.

Five independent variables were assumed to have influenced the yield of date palm. Those variables were the "total number of date palm trees of Households" ($X_1$), "land preparation method recommended by extension officials" ($X_2$), "frequency of irrigation" ($X_3$) "spending on pesticides recommended by extension officials" ($X_4$) and "farm-household income" ($X_5$).

### 3.2. Results

According to the model, these variables were responsible for significantly influencing date palm yield, explaining about **57.9%** of the variation in the yield. Of the five significantly influencing variables, "total number of date palm trees" was the only variable negatively influencing date palm yield. Therefore, where the number of trees is concerned, a decrease in the crop yield only comes about by increasing the number of trees. The results of the regression analysis revealed that the date palm yield decreased by 0.050 kg with an increase in the number of trees by one unit (Table 4). Farmers who used "land preparation methods recommended by extension officials" experienced a positive change in date palm yield by 17.73 kg. Date palm trees irrigated once a week yielded 10.95 kg more fruit than the trees irrigated less frequently, reflecting the important role that irrigation plays in determining date palm yield. The yield increased by 0.001 units when the spending on pesticides also increased by one unit. Finally, a one unit increase in the household income led to an increase in date palm yield of 4.42 units (Table 4).

### 3.3. Discussion

The general comparison of date palm yields of farmers with and without access to extension services revealed that the yield of the former type of farmers is higher than that of the latter type of farmers. This indicates that, although not particularly effective, extension services had contributed to an increase in date palm yield. However, the linear regression analysis proved that, besides extension, several other factors had influenced date palm yield. The factors that significantly influenced the date palm yield were "number of date palm trees", "land preparation", "frequency of irrigation", "pest control" and "farm-household income". This section provides an explanation for the role of each of these factors.

#### 3.3.1. Date palm holding

The analysis shows that the production of dates significantly decreased with an increase in the number of date palm trees. Without any significant difference in labor force (an average of 2 household members engaged) within farmer groups, medium and large-scale farmers could not effectively take care of an increased number of date palm trees. For instance, when it comes to medium- and large-scale farmers, each farmer was responsible for taking care of more than 200–300 date palm trees in the study area; it was not easy to manage as a high number of date palm trees were being cultivated by a limited number of farmers. On the other hand, medium- and large-scale farmers were also engaged in supplementary income-earning activities such as petty business. Therefore, they did not give much attention to improving date palm yield. However, each small-scale farmer was supposed to take care of approximately 50 date palm trees, where they could easily manage 100 (average) date palm trees. For instance, small-scale farmers were able to mitigate technical problems such as rodent bites and Sherago, which eventually boosted production.

#### 3.3.2. Land preparation

Agriculture extension officials had advised farmers to plow/hoe date palm farms twice a year, apply organic fertilizer to trees, and plant tree seedlings at intervals of 20–25 feet in order to facilitate proper growth and the good health of trees. These are necessary conditions to ensure a high yield of any crop. The findings of the regression analysis indicate that the farmers who had taken care of their date palm trees by following such advice enjoyed a higher yield of date palm than those who had not heeded the advice. However, not all farmers who received advice ignored it deliberately. As discussed in the context of the number of date palm trees, preparing land following extension officials' recommendations required a lot of labor, which

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was beyond the affordability of farmers with a relatively large number of date palm trees and a very small household labor force.

### 3.3.3. Irrigation

As per extension officials' recommendations, farmers were supposed to irrigate their date palm farms every day or at least twice a week to ensure an optimum yield. However, more than 90% of farmers mentioned that they did not have sufficient water to irrigate their date palm trees as per this recommendation. While the ground water was tapped by making tunnels, locally called *Kariz*, this was the only major source of irrigation. The amount of water available was not adequate to irrigate date palm even twice a week, not to mention daily, due to poor maintenance of *Kariz* and the frequent occurrence of drought. Farmers mentioned that the volume of water in *Kariz* had decreased by 50–70% within a decade. As a result, 82% of farmers could only irrigate their farms once a week. The findings of the regression analysis clearly indicate the crucial role of irrigation in determining date palm yield. The farmers who could irrigate their farms more frequently were the ones who enjoyed a high date palm yield.

### 3.3.4. Application of pesticides

Extension officials had also advised farmers to apply pesticides to date palm to prevent common pests such as rats and dubas bugs, which were damaging date palm trees and fruits frequently. Specifically, the officials had advised the farmers to apply Aluminum Phosphide to control rats, and to apply Confidor to control dubas bugs. However, the farmers could not apply these pesticides for two main reasons. First, small-scale farmers could not afford the cost of these pesticides. Second, farmers did not have appropriate pesticide sprayers to reach the crowns of tall trees. Therefore, as revealed by the regression analysis, the date palm yield increased by increasing the application of pesticides, as reflected in their cost.

### 3.3.5. Farm income

Any production activity requires financial investment. Agriculture is not an exception. Farmers need a certain amount of cash to buy needed materials and carry out necessary activities. In the case of date palm, farmers needed cash to buy fertilizer and pesticides, and to irrigate farms. Since there was variation in farm-household income, not all of the farmers had enough income to meet the cash requirement. As a consequence, farmers with a relatively high income could use required materials and take care of the crop properly, while farmers with a relatively low income could not do so. This is corroborated by the result of the regression analysis that found an increasing crop yield with an increasing household income; thus, the findings of this research are consistent with many other studies carried out worldwide (Mofakkarul-Islam et al., 2011; Lukuyu et al., 2012; Benjamin, 2013).

## 3.4. Conclusion and recommendations

The Government of Pakistan instigated agricultural extension policies (GoP, 2004) to address agricultural problems concerned with improving production through effective linkages among the extension centers and researchers by involving smallholder farmers (in particular) in the problem-solving and decision-making processes, and by disseminating useful knowledge, skills and information. Following the national agricultural extension policy of Pakistan, the provincial government of Balochistan has provided extension services. However, what was being practiced in the field was not consistent with what was written on the policy paper. Contrary to the policy that emphasizes a decentralized, participatory approach to extension, extension services were being provided through the traditional top-down operationally system based on the perceived needs of extension officials. Extension officials paid visits to the farmers only upon request from the farmers themselves. Identification of problems through successful farmer interaction and building farmers' abilities to address problems or to use new technologies, which are some of the core values of a participatory extension, was never practiced. Consequently, the highest majority of farmers were dissatisfied with the extension services provided. While the sheer number of farmers per extension worker was too high, for example, 2000–2400 households per field assistant, the extension officials based at both the district headquarters and in the field did not possess the knowledge and skills required to address any date palm specific problems. This was attributed to the age-old educational and training systems which focused on the typical main country crops. It is virtually impossible to provide effective extension without addressing such fundamental weaknesses of the service.

Overall, farmers in the study area were found to have very poor access to extension services due to a combined effect of several factors. This was partly attributed to institutional constraints, including a very limited number of extension workers and their lack of knowledge on how to address date palm-specific problems, such as the Dubas bug, which had infested approximately 90% of trees, and the shortage of irrigation water for around 90% of farmers, which caused a 65% decrease in date production. There is still a lack of modern technology and products, such as pumps to apply effective pesticides on taller date palm trees (around 10–15 feet). The rugged topography of the region, combined with a lack of all-weather roads, also obstructed famers' visits to extension workers and vice versa. While the production of date palm had steadily decreased over the years, mainly due to a Dubas bug infestation and date palm infertility, the extension provided had failed to help farmers solve these problems. All of these factors explain the wide-scale farmer dissatisfaction with agricultural extension.

The results of this study indicate that access to extension services can help a lot in assessing the usefulness and use of recommended knowledge and technology by farmers, despite the fact that the majority of farmers could only meet extension workers once a year. Of the farmers who had access (78%) to extension services, the highest proportion of all types of farmers found extension services useful with regard to land preparation and irrigation methods, although the findings were slightly different with small variations between each farmer group in terms of pest control. However, around half of all farmers had used the knowledge/technology provided by extension officials on land preparation and pest control.

The analysis of the effect of extension on crop yield indicates that the extension on land preparation, pest control and irrigation can play a significant role in improving crop yield and, ultimately, farmers' income. Despite a focus on extension, the findings of this study also revealed that

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provision of an effective extension services alone cannot ensure the intended improvement in the yield. Landholding size, availability of required labor, and adequate capital to manage inputs, including fertilizer and pesticides, play equally important roles in enhancing crop yield.

The analysis of the effect of extension on date palm yield clearly indicates that extension services can play an important role in improving crop yield. However, the agricultural extension in its current state has not been particularly effective for various reasons as reflected in the findings of this study. Addressing these shortfalls entails an improvement of agricultural extension in Balochistan with a focus on the following recommended measures.

### *3.4.1. Revision of extension curriculum and extension workers' capacity building*

As date palm represents the main economic livelihood of a considerable percentage of farmers in Balochistan in general and in the study area in particular, the Government of Balochistan needs to pay serious attention to addressing the production problems faced by date palm farmers in its jurisdiction. Learning lessons from this study, the Government of Balochistan as well as governments in other developing countries may reconsider to design location-specific extension programs. This would require, among other things, making provision of an adequate number of well-qualified extension officials, including field-level agents who would be effectively able to understand and address location-specific production constraints. Ensuring the availability of an adequate number of well-qualified extension officials would entail a radical change in academic curricula and training course contents including establishment of Farmer Field Schools. Such changes to the curricula and training courses may be taken into account location-specific diversities in terms of production potential and constraints. The old policy of requiring farmers to visit extension agents has to be changed in order to improve farmers' access to extension services, particularly in rural areas where public transportation is not readily available. Following the principles of participatory extension services, the new policy requires extension officials to work in cooperation with the farmers. Finally, it is necessary to place emphasis on building and expanding rural transportation infrastructures, including all-weather roads, in order to facilitate smooth interaction between farmers and extension officials.

The findings of this study revealed that approximately 90% of farmers did not have sufficient irrigation water and the highest proportion (approximately 90%) of date palm trees were infested by the dubas bug; therefore, there is an emerging need that the Government and I/NGOs reconsider to 'rehabilitate' the karizes and date palm trees infested by the sherago/Dubas bugs. In addition, since it is one of the poorest districts of the country, farmers may be provided with agricultural grants, in terms of cash, pesticides and farm equipments such as hand pumps to approach the tall date palm trees. Such measures eventually improve the volume of irrigation water, production and farm-income.

### *3.4.2. Proactive approach to extension*

Following the principle of participatory extension, extension agencies require to adopt a proactive approach to extension. In this regard, instead of visiting farmers upon their request, the field-level extension agents, as well as the district and provincial headquarters-based extension officers and subject matter specialists, need to routinely visit their respective areas of responsibility and discuss the difficulties faced by the farmers. The latest studies on agricultural extension services indicate that participatory extension services have resulted in sanguine impacts on farmers' knowledge and skills as well as on production (Bernet et al., 2001; World Bank, 2010; Mofakkarul-Islam et al., 2011; Lukuyu et al., 2012; Benjamin, 2013). In this regard, extension officials themselves need to initiate a proactive approach, which would require the officials to visit farmers in order to familiarize themselves with the location-specific constraints of the farmers and then to extend the necessary assistance required to address those constraints. The field extension agents may refer farmers to subject matter specialists if it is beyond their capability to solve any crop-specific problem. While visiting farmers, attention needs to be paid to senior or illiterate farmers. The analysis showed that farmers who had inherited most of their date palm trees received the least access to extension. Moreover, to enable field extension agents to deliver needed services effectively, it is necessary to arrange transportation facilities for them, such as motorbikes, or to provide traveling allowances.

### *3.4.3. Farmer-to-farmer extension*

The provision of an inadequate number of field-based extension workers, each of whom has to serve 2000–2400 households per field assistant, is not going to serve the purpose, even if the workers are well equipped with the required knowledge. Therefore, it is necessary to increase the number of extension agents. However, due to budgetary constraints, the District Agricultural Extension Department may not be able to recruit an adequate number of agents. Therefore, the DAED needs to consider recruiting some progressive date farmers as extension workers who would have to undergo field-based hands-on training to strengthen their technical knowledge.

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