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VEGETABLE PRODUCTION IN NEPAL – A NEEDS ASSESSMENT

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ABSTRACT

An analysis of the major factors influencing the successful production and marketing of vegetables is undertaken. Suggestions to concentrate research and development activity on two major foci-extension of production season in existing pockets of vegetable production, and analysis of comparative advantages of additional production niches for off-season production – are made. The accompanying policy and research investment in order to effect these suggestions are outlined.

Additional Key Words: Markets, infrastructure, seed, hybrids, IPM, database, indigenous vegetables.

INTRODUCTION

Enhanced production of fresh vegetables and vegetable seeds are viewed by the Agricultural Perspective Plan (APP) as two of the seven high-value enterprises that merit focused government action over the 20 year period (1995-2015). Their capacity to generate income for various hill and mountain agro-ecosystems, to create demand in hill communities for lowland-produced food staples, and to satisfy the increasing demand from the lowland and export markets, are the key arguments for such investment. This approach is espoused by the private sector in agriculture e.g. the Agro Enterprise Centre (AEC) of the Federation of Nepalese Chambers of Commerce and Industry (FNCCI) and is supported by fragmented pockets of research and development through Nepal.

The complexity of current vegetable production systems, and of those within which vegetables must be introduced in the future, and the paucity of resources available for research and development activities, dictates that a broad analysis of the national vegetable demand and supply be undertaken to determine at what level suitable interventions may be made to expand and maintain production levels. This brief analysis also highlights the necessary policy and infrastructure support required to promote and sustain profitable vegetable production.

VEGETABLES NATIONWIDE

Most recent data (Thapa and Paudyal, 1999) estimations for annual per capita vegetable consumption suggest values of 50 kg based upon 1992/3 production data of 1.12 million tons (t), population of 18.5 million, and 20% post-harvest losses. Vegetable production in Nepal has been consistently increasing, due to area expansion (until the mid 1980's) and enhanced productivity (from the mid-1980's on wards). Much of the increased productivity was due to implementation of a Special Programme, where yields more than doubled (6 t/ha to 15 t/ha) due to timely access to inputs, technical services and improved seed. Despite these encouraging improvements in Nepalese supply of vegetables, a number including onion, garlic and tomato (and potato-but not considered herein as a vegetable) were continuously imported from India. For example, imports of onion and garlic increased from 4,800 t in 1982/83 to 11,400 t in 1987-8 (Thapa and Paudyal, 1999). Import and export of vegetables is currently erratic, due to the status of surpluses and shortages, and of vegetable trade policies. Such surpluses and shortages fuel the drastic

fluctuation of vegetable trade prices, and indicate the current inability to ensure year round supplies of each vegetable commodity, whether through inappropriate planning or non-application of suitable production practices (i.e, varieties and agronomy). Restricted access to vegetables in the rural mountains and rural hills, due to poor access for trade and to inclement winter weather, leads to marked regional differences in vegetable consumption in Nepal (NRB, 1989). The shortfall in the highlands is made up through consumption of potatoes. Vegetable consumption is greatest in the urban hills, reflecting the close integration sites with markets.

Farmers grow vegetables because of their profitability. Estimates of profitability suggest that on average net returns from vegetables are five times those from cereals (Jansen *et al.*, 1994), but that great temporal and spatial variability exist, with marked losses in glut periods. The bust and boom cycling in vegetable production is very prevalent, indicative of the need for a comprehensive information management system relating market demand to area planted.

That vegetables are improved from India suggests that characteristics of the India production systems favour economics of production over and above those of Nepal. It is ironic that Nepal, with its unmatched diversity of agro-ecological zones and climatic resources to (theoretically) produce vegetables year-round, should be required to import vegetables from India. If export of vegetables from the hills of Nepal to India is envisaged, and it has been quite recently (Koirala *et al.*, 1995), then comparative analyses of vegetable production systems, and their policy environments, are indicated. Koirala *et al.*, (1995) have analysed the competitiveness of Nepalese farmers in the domestic market (vs. Indian imports). Their study shows that research investment in Indian horticulture is greater per capita than in Nepal, and that productivity growth rates for all important cash and food crops (with the exception of sugarcane and potato) are greater too. This, coupled with the under-investment in agricultural infrastructure, with treaty-supported trade regimes favouring Indian produce in Nepal, and finally with the overvalued Nepalese currency, all contribute to the trade edge in vegetables of India over Nepal.

Indeed, the very success of the APP will depend upon policy and investment that turn around such disadvantages to Nepal. Without this package in totality, research into new spatial and temporal ventures with horticulture will be subject to failure. The successful Rapti Development Project attests to the validity of concentrating financial and technical resources, and infrastructure, into relatively remote communities to kick-start their integration with, and physical access to, markets; ready availability of indispensable inputs (especially high-yielding vegetable varieties); competent District Agricultural Development Officers (DADO), and concentration on early and off-season (i.e., summer season) vegetable production that provide greater net returns per unit land area than do alternative commodities.

THE WAY AHEAD NATIONALLY

The term "vegetables" encompasses species adapted to all known environments sustaining food production. Their specificity to agro-ecological zones has been shown to be dominated by two major constraining factors (Midmore and Poudel, 1996): temperatures too hot or cold for temperate and tropical species, respectively, and environments too dry (the latter without irrigation). The anthropomorphic nature of vegetable cultivation systems that requires proportionately greater inputs than for extensively grown crops, ensures that the producer makes good, through objective inputs, the deficiencies of the growing environment. Even without extensive use of inputs, many vegetable species can be grown across traditionally defined agro-ecological zones during one or other period of the year.

This flexible temporal and spatial adoption of vegetables, and the attendant inputs available to extend successful production to less favourable locations or times of the year, results

in a multiplicity of options for research and development with vegetables, and transcends the agro-ecological approach to defining production systems, recommendation domains and the like. Superimposed on this, though, are the seasonal and spatial aspects of markets for vegetables. As vegetable production is demand driven, access to markets plays an important role in the location of vegetable production. Data for 1995/96, for which total vegetable production in the Central Region (49%) compared to the Eastern Region (24%) and the isolated Far Western at 3% (Thapa and Paudyal, 1999). Although each region has a similar proportion of land within the major agro-ecological zones of Nepal and, therefore, theoretically the same capacity for production of vegetable across those zones, it is the region with the largest market that dominates production. If road infrastructure were well developed, it is possible that a more equitable share of production of vegetable production pockets along those roads, with assured easy access of inputs and outputs, laid the foundation for success in the Rapti Development Project.

Well-established production pockets also lie along the major E/W and N/S arterial roads. Proximity to roads minimises the costs of manual transport of inputs e.g., organic and inorganic fertiliser, and of fresh produce to collection centres, and reduces the post-harvest losses attributable to that phase of the transport and marketing systems. Overall, estimates suggest that from 20-35% losses (weight losses, including loss of water) arise in the post-harvest and transport chains for cabbage and tomatoes, with attendant 16-25% loss of price due to the associated poor quality of produce. (Werner and Kaini, 1997 and cited references therein). Attention to quality control through management of pre-and post-harvest practices was one of the factors determining the success of the Rapti Development Project (John Mellor Associates and IIDS, 1995). Poor, although undetected, quality of vegetables is also attributable to their pesticide residue levels. Over 80% of fresh vegetable samples (163 samples tested in 1992/3) analysed by the Central Food Laboratory were contaminated with pesticides, and DDT levels in 76% of samples were above accepted levels (Thapa, 1997). Cheap imports of pesticides from India, and 25% price subsidies on spray equipment promote pesticide usage, and disadvantage efforts to establish IPM practices (Baker and Gyawali, 1994).

It is clearly apparent that a number of infrastructure, policy and equity decision must be effected before returns to vegetable research accrue to the farmers, their communities and the country as a whole.

TWO MAJOR RESEARCH EMPHASES

The dominance of market demand, and producer access to markets, within the vegetable arena suggests that major research emphases be undertaken. Both will require a set of changes to policy and infrastructure to ensure their success.

The first builds upon current vegetable production pockets along roads, and involves extending of the production season, through choice of new varieties, management practices, or even species. The justification for this is to increase the off-season production in areas where the basic marketing infrastructure and information links with key markets exist. The 30 sites chosen by the Small Marketing Infrastructure Project (SMIP; Werner and Kaini, 1997) for investment and expansion should also be the focus of analysis for season extension, and subsequently production research. This will ensure synergies between them. The planned telephone links within the SMIP can only enhance market integration of the current and future vagetable production system. A close allegiance between the Market Development Division (MDD) of the Department of Agriculture (DOA) and the research arm of National Agricultural Research Council (NARC) will underpin the success in these areas. Access by farmers to improved post-harvest handling introduced by the Vegetable Department Division (VDD) in some production

areas, especially during the off-season when produce resilience might be impaired, provides an additional argument for such an approach.

The second builds upon an analysis of comparative advantages of production niches favoured for the extended production of off-season vegetables. The approach to this analysis is outlined later. NARC, development agencies, Government and Non-Government Organisations (GO and NGO), entrepreneur traders and researchers in the vegetable disciplines will need to lobby His Majesty's Government of Nepal (HMGN) for road access to the chosen sites. Joint ventures between HMGN and the private sector could provide an avenue through which such proposals are progressed to fruition. Concurrent with infrastructure development would be the setting up of market access, the introduction of appropriate production technologies (see later for discussion on their development), and the formation of producer/marketing groups. Although hypothetical as presented above, such schemes have worked in Nepal, and in other Asian countries (e.g., the Cameron Highlands of Malaysia and the WuLing area in Taiwan).

REQUIRED POLICY AND INFRASTRUCTURE SUPPORT

As stated before, and reiterated here, success will not be forthcoming without adequate policy and infrastructure support. These are affirmed below, based upon analyses by Thapa and Poudyal (1999), Baker and Gyawali (1994), Jodha (1997), and Kaini and Werner (1997). Following on from these, the researchable issued to be addressed by NARC to support vegetable production are outlined.

Availability, and quality, of non-biological inputs

Farmers spend considerable amounts of time accessing necessary inputs for vegetable production, as a result of the considerable distances to travel and the uncertain supply. When crops fail due to poor quality inputs, extra time is wasted due to the need to replant. Establishment of producers' associations could ensure that pressure be brought on government to insure steady input supply, and quality assurance through enforcement of existing regulations (e.g. Seeds Act, Pesticide Act). It is quite frequently heard that it is not the price of fertiliser that limits it use, but the timely availability of the fertiliser.

Infrastructure beyond tracks and roads

It is not only in Nepal where vegetables are produced on steeply sloping lands with access impediments. These use of gravity pulley systems in the Cameron Highlands of Malaysia, and of trail networks in the highlands of Taiwan assist in movement of both inputs and outputs. Nevertheless, promotion of sturdy and standardised reusable plastic crates will improve post-harvest handling and reduce associated losses. This links closely with the SMIP activities, as does development of marketing infrastructure and grading facilities. Collective transport systems are also imperative, for the major constraint to increased production in some newly-opened vegetable production pockets (e.g., Dhordeni near Bajung) was, without exception, lack of transport facilities.

Input subsidies

Price paid for urea represents 55% of actual cost, and further subsidy exists for remote areas. This is in line with the Indian subsidy on urea. While this may make for unsustainable use of nitrogen (over-application due to low price), this is unlikely at the present and anticipated scales of production. Subsidies on nitrogen, but not on sources of phosphorous and potassium, can lead to unbalanced nutrient supply to crops, limiting response to the inorganic nitrogen. Of

greater concern is the direct inducement to use pesticides, by way of a 25% subsidy on spray equipment, and the free movement of (often poor quality) undesirable pesticides from India. The equipment subsidy could be recast as a subsidy on IPM sweep or trap apparatus, encouraging their economic acceptance. The whole question of regulation of pesticide usage is broad, and deserves attention as IPM approaches are promoted and practices. Subsidised seed, for a limited period only as production takes off, is another area for analysis.

Market support systems

Market margins are generally excessive (producers often only receiving 10% of retail price if marketing costs are charged to returns, although Bhattarai and Subedi (personal comm.) suggests that 20-25% of retail price goes to farmers in general). Much of the losses, both in produce and price are due to poor availability of market intelligence. Working with the private sector, the government should provide market information for the good of all in the chain: producer – wholesaler – retailer – consumer. The relationship between Kalimati wholesale market prices and regional market prices need to be examined, the determine whether Radio Nepal should relay regional market information or not. Should such information be relayed, conversing of farmer opinion on the utility of the same should follow.

REQUIRED RESEARCH TO BE ADDRESSED BY NARC

The areas to be addressed by NARC, in promoting increased vegetable production are broad and varied. NARC's experience to date with horticultural research has been limited. As the Evaluation Report for the Rapti Development Project Status: *"The horticultural activities of the line agencies continue to be thinly spread in the district and suffer because of the lack of both manpower and resources."*

NARC's proportion of its budget assigned to vegetable research in 1997/8 was 3% (Joshi and Poudyal, 1998). For successive years much of this be available for competitive bidding amongst vegetable scientists, as Lumle Agriculture Research Centre (LARC) and Pakhribas Agriculture Centre (PAC) are Integrated into NARC. It is imperative that the areas funded for research are aligned with a country wide vegetable production policy, for fresh vegetables and vegetable seed. The focus of the research could be as outlined above; in existing areas to extend seasons, and in new areas to complement that currently produced and anticipated from existing areas. A proportional budget allocation of 4:1 could be envisaged, for immediate payback to research on the existing sites will justify further HMG/N investment, while that in the new sites ensures a progressive opportunity to supply all vegetable species throughout the calendar year. Specific researchable issued for NARC in general are presented below in decreasing order of importance. This list is short, for it is considered that major emphasis be placed only on this cost-effective research.

Production of high quality seed

It is lamentable that Nepal cannot satisfactorily supply high quality seed for its own vegetable farmers, let alone export to adjacent countries. Examples of mixtures, reported by farmers, of even the most simple of species (tomato) for open-pollinated seed production are widespread, with progressive farmers having little recourse but to access imported quality seeds. Quality seed begins with the responsibility for maintenance of variety, breeder and foundation seed, presently under the control of research stations releasing varieties. Given the lack of central funding for a vegetable gene bank, the current system would appear to provide the most reliable procedure for basic seed production, following established principles for individual species.

Regular contact and supervision by NARC and VDD staff of seed production nurseries (in the public and private sectors), and review of the suitability/rationale for seed production), are necessary in the short term. Without sustained supply of essential inputs to private and public sector seed nurseries, fresh vegetable production opportunities will be lost. The current demand for vegetable seed is estimated at > 1000 t of which only 40% is satisfied with "quality" seed (data from Yonjon, 1998- for 1992/3). Although most studies have shown seed production to be economically feasible, some simple coordinated experiments could determine the optimum sites (socially, economically and technically) for which attention should be focussed.

In part it is responsibility of Seed Entrepreneurs Association of Nepal (SEAN) to verify the quality and purity of seed sold, and simple seed quality and purity evaluations by NARC of commercially available seed should lead to black-listing of recurrent offenders. This is entirely in the domain of NARC, unless SEAN institutes a self-moderated procedure.

Production of hybrids and hybrid seed

As an extension of the above, and in response to farmer-driven demand for F_1 hybrid seed, research efforts should focus on (a) the development and/or acquisition of inbred lines for ideally locally adapted F_1 hybrids and (b) environmental and management requirements for production of high volumes of seed. Choice of one or two suitable hill stations, and concentration of research effort and inputs therein, should ensure a continual source of funds from sale of F_1 seed for the stations, and seeds for the farmers. Cost-benefit analyses should accompany the initial trials. The development of inbred lines may take time, but for tomato they already exist and could be evaluated on a semi-commercial basis. The choice of species for hybrid seed production should be limited to those where an obvious financial and/or adaptational advantage is presented. No more than four to six species would be reasonable in the first instance. In particular, the development of varieties (F_1 of OP) should be promoted for off-season vegetable production. For both open-pollinated and F1 hybrid seed, a simple system for variety testing must be established, to ensure exclusion of indiscriminate imports of unsuitable varieties, and to avoid promotion of other varieties unsuitable for specific local conditions. The SEAN must in part be financially responsible, especially for the registration of varieties sold by their members. A system involving four to five sites, for two seasons, should suffice for registration, for the industry cannot financially support a system as extensive as those for the major grain industries.

The public sector, should it be decided that commercial F_1 seed production is not in its interest, may elect to sell the rights to inbred lines and the information on specific parental combinations. Such an approach is becoming a reality amongst other publicly-funded institutions (e.g, the Asian Vegetable Research Development Centre in Taiwan) and strengthens the sustainability of research institutions traditionally dependent upon a (declining) budget provided by government.

Postharvest technologies

While mentioned here, technologies are currently being developed within the SMIP, and are best left to the Department of Agriculture (Development) during the current funding climate. Nevertheless, as NARC and SMIP mutually support each other with new technologies, the intellectual involvement by NARC is not to be played down. As new varieties, and non-seasonal produce, are developed by NARC, a close relationship must exist in evaluation of post-harvest characteristics at the semi-and commercial level.

Off-season production practices

A series of practices will be evaluated at designated research and farmer sites in accordance with existing/proposed marketing infrastructure, and with climatically suitable sites chosen objectively. These will include technologies such as microenvironment manipulation (the use of transparent plastic sheeting for forcing production is gaining ground), intercropping techniques, methods for and timing of planting, type of materials for planting (e.g., for onion, shallot) and the like. Many of these practices have been researched by SAVERNET (AVRDC, 1997), some with outstanding success under less than optimal conditions for traditional vegetable production.

National vegetable database

Data on area, production and yields of the most important individual species, by district, are required for planning, policy analyses and for evaluation of research investment. This could be undertaken on alternate year, with the off-years being devoted to analyses of farm level profitability for a determined number of farms across the country. A sample of between 100-200 would be adequate, with 10-20 representing each production system. In this way, the competitiveness of the vegetable production system could be compared against that of alternative crops.

Integrated pest management

The more involved farmers become in IPM, the better it works for them. Hence new options need to be researched, to broaden the non-pesticide arsenal against destructive pests and diseases. The removal of sprayer subsidies, and taxation of pesticides will assist expansion of IPM activities. As an example, in Cuba, following the fall of the Eastern Block Communist System, pesticides were increasingly unavailable and IPM practices become increasingly effective. Feeding of new research results on biological control to private companies will assist in initial build-up of predators, as in other countries (e.g., Australian-Bugs R Us) that promote IPM and the clean-green image. IPM practices have great scope for efficient control of pests in intensive production systems, such as around Kathmandu (Jansen *et al.*, 1994) with concomitant improvements in the ambient environment.

Responsive research

A small proportion of research effort must be directed towards the ongoing problems that arise with continuos vegetable production. Presence of new pests and diseases such as tomato yellow leaf curl virus will require attention, as will new technologies introduced and/or developed by farmers keen to improve their productivity.

Indigenous vegetables

Nepal as a country is rich in diversity of indigenous vegetable species, which contribute substantially to the diet of isolated communities (Budathoki *et.al.*, 1992). Collection and conservation of this germplasm will are important as such communities are integrated into the market system. As this is unlikely for the near future, and as the indigenous communities conserve germplasm in vivo, great emphasis need not be placed on these vegetables species. Subsistence food systems are notoriously complex and defy traditional research/statistical approaches for their improvement (Midmore *et al.*, 1991). For this reason, the subsistence vegetable production systems are best left to the attention of development agencies unless species are removed for evaluation under commercial systems, or produce is sold from the

subsistence system. However, inasmuch as commercial vegetable production will eventually penetrate to the areas of subsistence communities, land-races with known tolerances to diseases, pests and biotic stresses should be collected and conserved for future incorporation into breeding programmes.

Since NARC staff with specific responsibility for vegetables are spread over a number of research stations ranging in attitude form 90 to 2400 masl, it is suggested that these be aggregated for hot, humid, vegetable production could be addresses in the Terai or in the river valleys during the summer seasons, while warm dry production could be researched in the midhills (site: Lumle). Therefore, it may not be necessary to maintain vegetable research staff at all stations. Fore example, the newly acquired site at Khumultar could justify only one (based upon extent of land) and perhaps no (based upon the environmental suitability for seed production) research staff.

Concurrently, the assignment of research responsibility across commodity crops (as underway at LARC and PAC) to perhaps on the basis of botanical families for lateral synergy of research, will increase accountability for use of research resource, for only cost-effective research should be funded. Cooperation between staff of different stations, for use of specialised resources at one or other station, is anticipated. An internal system for accountability, quantified on the basis of economic returns occurred, should be matched against an *ex ante* analysis of anticipated benefits from the research. While threatening upon first impression, such schemes are the mainstay of private enterprise and should be equally effective in the public sector.

NARC (vegetables) should consider the establishment of a commercial arm, that will allow researches to commercialise their findings, particularly in seed production, with a percentage returned to NARC. This will motivate the undertaking of correct practices for production and post-harvest (i.e. drying, threshing, cleaning, grading) of seed crops, currently one of the major factors limiting expansion of vegetable production.

At the national level, and in parallel to the Vegetable Marketing board (VMB), a Vegetable Production Board should be established, building upon SEAN and anticipated farmer groups, for the coordinated souring and identification of markets, inputs, seeds and production opportunities availed by NARC research. The active involvement of DOA staff on the board, and in all R & D activities of NARC is absolutely necessary for a thriving vegetable industry. Measures to coordinate field activities of NARC and DOA to improve vegetable production must be implemented immediately.

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